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REPORT

OF THE

TESTS OF METALS

AND

OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES,

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL, MASSACHUSETTS,

DURING THE

FISCAL YEAR ENDED JUNE 30, 1902.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1903.

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UNIVERSITY

LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING,

WITH A LETTER FROM THE CHIEF OF ORDNANCE, A COPY OF A REPORT OF THE TESTS OF IRON AND STEEL AND OTHER MATERIAL FOR INDUSTRIAL PURPOSES AT THE WATERTOWN ARSENAL.

WAR DEPARTMENT,
Washington, January 28, 1903.

SIR: I have the honor to transmit herewith a letter dated January 24 instant, from the Chief of Ordnance, U. S. Army, together with a copy of the report of the commanding officer at Watertown Arsenal, of "tests of iron and steel and other material for industrial purposes," made at that arsenal during the fiscal year ended June 30, 1902.

Very respectfully,

ELIHU ROOT, *Secretary of War.*

The SPEAKER OF THE HOUSE OF REPRESENTATIVES.

OFFICE OF THE CHIEF OF ORDNANCE U. S. ARMY,
Washington, January 24, 1903.

SIR: I have the honor to submit, for transmission to Congress as required by law, a copy of the report of the commanding officer, Watertown Arsenal, of "tests of iron and steel and other material for industrial purposes," made at the Arsenal during the fiscal year ended June 30, 1902, which has just been received at this office.

Respectfully,

WILLIAM CROZIER,
Brigadier-General, Chief of Ordnance.

The SECRETARY OF WAR.

70476

WATERTOWN ARSENAL,
Watertown, Mass., January 20, 1903.

SIR: I have the honor to submit herewith the annual report of tests of iron and steel and other materials made at this arsenal during the fiscal year ending June 30, 1902.

The total number of specimens tested during the year was 3,650, classified as follows:

Gun specimens	22
For Ordnance Department	373
For other Government departments	24
Investigative tests	2,539
Tests for private parties	692
Total	3,650

The receipts and expenditures were as follows:

Amount appropriated for testing machine and testing work	$15,000.00
Received from private parties during the year	550.20
Total received	15,550.20
Amount expended for services and labor	12,535.04
Amount expended for light, power, tools, implements, and materials for test	3,001.30
Deposited to credit of Treasurer, United States	13.86
Total expended	15,550.20

The tests for the Ordnance Department comprise specimens from the different caliber guns of current fabrication and the material for carriages and for shot and shell. Forged steel, steel and iron castings, and bronze are represented in this group of material.

There were tests of retraction and buffer bracket hooks, also proof stresses applied to piston rods and retraction ropes.

Hydrostatic tests were made upon thin sections of gun hoops, showing the strength of metal containing so-called streaks and corresponding material which was without streaks.

In the tests of rocker and track blocks, high compressive stresses were applied to a cylindrically faced block of large radius of curvature, which rested upon flat blocks of different kinds of metal. The conditions approached those present in the cubic compression of metals, and stresses of great intensity were endured before permanent deformation occurred.

Two steel ingots were procured for investigative tests, one containing 3½ per cent nickel, the other none. In respect to other elements they were of similar composition, as nearly alike as practicable to obtain. A number of illustrations show the appearance of these ingots when cut apart. There are tensile tests on the metal in the natural state of the ingot, also after heating, quenching, and annealing, from which may be seen the wide range in physical properties a given metal may display. Under the influence of repeated alternate stresses similar results appear, showing that the endurance of the metal may be augmented by the same means which increase the tensile strength.

Endurance tests on different grades of steel have shown that alternate tensile and compressive fiber stresses as high as 50,000 pounds per square inch may, for a considerable time, be sustained by some bars.

Tests were made on suspender rods from the New York and Brooklyn Bridge. The characteristics of those rods, which have been in service since the construction of the bridge, are fully shown.

The investigative tests of cements have continued. A number of tests have been made on cements exposed to low temperatures while setting. The severity of the conditions attending these experiments were ameliorated over the early tests on this subject. Initial periods of setting at ordinary atmospheric temperatures preceded the interval in cold storage at zero F. The results indicate that low temperature has a retarding influence of greater or less degree on the acquisition of strength, notwithstanding the chemical reactions may have been initiated and a partial state of induration acquired under normal conditions of setting.

There were absorption determinations and tests on the elastic properties of dry-pressed and mud brick taken from several parts of the kiln, showing the influence of exposure to different temperatures of burning, according to their position in the kiln.

Transverse tests on Douglas fir and oak wood appear in the report; also the adhesive resistance of lag screws and bolts in those woods is shown. Observations on heat conductivity were carried on with sticks of Douglas fir exposed over wood fires, and final tests for strength made on the uncharred parts.

Chemical analyses were made on the tested material.

Tests for private parties, as provided for by law, have continued as in former years. A list of the parties for whom tests have been made is appended to the report.

Very respectfully, your obedient servant,

JOHN G. BUTLER,
Lieut. Col., Ordnance Department,
U. S. Army, Commanding.

The CHIEF OF ORDNANCE U. S. ARMY,
Washington, D. C.

REPORT

OF THE

TESTS OF METALS AND OTHER MATERIALS

FOR

INDUSTRIAL PURPOSES,

MADE WITH THE

UNITED STATES TESTING MACHINE AT WATERTOWN ARSENAL, MASSACHUSETTS,

DURING THE

FISCAL YEAR ENDED JUNE 30, 1902.

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SPECIMENS FROM STEEL FORGINGS FOR 75-MILLIMETER MOUNTAIN GUNS.

BODY.

No. 7473.

Marks, B^{4}_{M}
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	.....	.....	
20,000	.00070	.00035	.....	.....	
30,000	.00105	.00035	.....	.....	
35,000	.00125	.00020	0.	0.	
40,000	.00145	.00020	.....	.....	
42,000	.00150	.00005	0.	0.	
47,000	.00185	.00035	.....	.....	
48,000	.00190	.00005	.....	.....	
49,000	.00200	.00010	.....	.....	Elastic limit.
50,000	.00250	.00050	.....	.....	
51,000	.00310	.00060	.....	.....	
52,000	.00390	.00080	.....	.....	
53,000	.00460	.00070	.....	.....	
54,000	.00570	.00110	.....	.....	
97,100	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	97,100
Elastic limit per square inch of original section	do...	49,000
Elongation per inch after rupture	inch..	.235
Elongation per inch under strain at elastic limit	do...	.00200
Reduction in diameter at point of rupture	do...	.135
Reduction in area after rupture, per cent of original section		46.2
Position of rupture		1".18 from neck
Character of broken surface		silky
Elongation of inch sections		".19, ".28*

BREECHBLOCK.

No. 7468.

Marks, $\frac{74}{52}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	.....	.....	
10,000	.00035	.00020	.....	.....	
20,000	.00070	.00035	.....	.....	
30,000	.00105	.00035	.....	.....	
40,000	.00145	.00040	0.	0.	
46,000	.00160	.00015	0.	0.	
50,000	.00175	.00015	.....	.....	
55,000	.00195	.00020	.....	.....	
57,000	.00200	.00005	.....	.....	
58,000	.00205	.00005	.....	.....	Elastic limit.
59,000	.00240	.00035	.....	.....	
60,000	.00275	.00035	.....	.....	
61,000	.00350	.00075	.....	.....	
62,000	.00500	.00150	.....	.....	
63,000	.00600	.00100	.....	.....	
64,000	.00720	.00120	.....	.....	
103,900	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	103,900
Elastic limit per square inch of original section	do...	58,000
Elongation per inch after rupture	inch..	.225
Elongation per inch under strain at elastic limit	do...	.00205
Reduction in diameter at point of rupture	do...	.155
Reduction in area after rupture, per cent of original section		51.9
Position of rupture		".70 from neck
Character of broken surface		silky
Elongation of inch sections		".33*, ".12

Block Carrier.

No. 7469.

Marks $\frac{125}{43}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00015	.00015	0.	0.	
10,000	.00085	.00020			
20,000	.00070	.00085			
30,000	.00105	.00035			
40,000	.00140	.00035	0.	0.	
46,000	.00155	.00015	0.	0.	
50,000	.00170	.00015			
54,000	.00190	.00020			
55,000	.00195	.00005			Elastic limit.
56,000	.00450	.00255			
57,000	.00600	.00150			
58,000	.00670	.00070			
59,000	.00770	.00100			
60,000	.00875	.00105			
61,000	.00950	.00075			
95,500					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	95,500
Elastic limit per square inch of original section	do...	55,000
Elongation per inch after rupture	inch..	.255
Elongation per inch under strain at elastic limit	do...	.00195
Reduction in diameter at point of rupture	do...	.165
Reduction in area after rupture, per cent of original section		54.6
Position of rupture		1".10 from neck
Character of broken surface		silky
Elongation of inch sections		".33*, ".18

TABULATION OF TENSION SPECIMENS FOR 75-MILLIMETER R. F. MOUNTAIN GUNS.

STEMS 3" LONG, ".505 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
7473	Body	Middle	49,000	97,100	23.5	46.2	Silky	Breech end.
7468	Breechblock		56,000	103,900	22.5	51.9	do	
7469	Block carrier		55,000	95,500	25.5	54.6	do	

6-INCH R. F. GUNS.

SPECIMENS FROM TUBES, JACKETS, HOOPS, AND BREECHBLOCK.

TUBE.

No. 7448.

Marks, $^{6\ R\ F_{M}\ T}_{M\ T_{6}\ M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025			
20,000	.00060	.00025			
30,000	.00100	.00040			
35,000	.00115	.00015	0.	0.	
40,000	.00130	.00015			
42,000	.00140	.00010	0.	0.	
50,000	.00160	.00020			Elastic limit.
51,000	.00190	.00030			
52,000	.00215	.00025			
53,000	.00250	.00035			
54,000	.00345	.00095			
55,000	.00450	.00105			
98,000					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	98,000
Elastic limit per square inch of original section	do...	50,000
Elongation per inch after rupture	inch..	.205
Elongation per inch under strain at elastic limit	do...	.00160
Reduction in diameter at point of rupture	do...	.115
Reduction in area after rupture, per cent of original section		40.3
Position of rupture		".65 from neck
Character of broken surface		granular 60 per cent, silky 40 per cent
Elongation of inch sections		".29*, ".12

TUBE.

No. 7449.

Marks, $\frac{6\ R\ F_H\ T}{M\ T_2\ M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	.....	.....	
20,000	.00070	.00035	.....	.....	
30,000	.00105	.00035	.....	.....	
35,000	.00120	.00015	0.	0.	
40,000	.00135	.00015	.....	.....	
42,000	.00140	.00005	0.	0.	
50,000	.00170	.00030	.....	.....	
51,000	.00175	.00005	.....	.....	Elastic limit.
52,000	.00200	.00025	.....	.....	
53,000	.00225	.00025	.....	.....	
54,000	.00315	.00090	.....	.....	
55,000	.00475	.00160	.....	.....	
56,000	.00620	.00145	.....	.....	
93,250	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	93,250
Elastic limit per square inch of original section	do...	51,000
Elongation per inch after rupture	inch..	.145
Elongation per inch under strain at elastic limit	do...	.00175
Reduction in diameter at point of rupture	do...	.055
Reduction in area after rupture, per cent of original section		20.5
Position of rupture		1".08 from neck
Character of broken surface		granular, a belt of flaky metal across surface
Elongation of inch sections		".14, ".15*

JACKET.

No. 7444.

Marks, $\frac{6\ R\ F_{ss}\ J}{M\ T_1\ 6}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000067	.000067	0.	0.	
10,000	.000267	.000200			
20,000	.000600	.000333			
30,000	.000933	.000333			
40,000	.001267	.000334	0.	0.	
46,000	.001433	.000166	0.	0.	
52,000	.001633	.000200			
53,000	.001700	.000067			Elastic limit.
54,000	.002000	.000300			
55,000	.002333	.000333			
56,000	.003300	.000967			
57,000	.004000	.000700			
58,000	.005000	.001000			
99,680					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	99,680
Elastic limit per square inch of original section	do...	58,000
Elongation per inch after rupture	inch..	.20
Elongation per inch under strain at elastic limit	do...	.001700
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture		1".4 from neck
Character of broken surface		silky
Elongation of inch sections		".19, ".31*, ".10

JACKET.

No. 7445

Marks, $\frac{6\ R\ F_4\ J}{M\ T_1\ O}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	In'tial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
20,000	.000633	.000333	.....	.....	
30,000	.000967	.000334	.....	.....	
40,000	.001300	.000333	0.	0.	
46,000	.001500	.000200	0.	0.	
51,000	.001667	.000167	.....	.....	Elastic limit.
52,000	.003300	.001633	.....	.....	
53,000	.004600	.001300	.....	.....	
54,000	.006833	.001233	.....	.....	
55,000	.006333	.000500	.....	.....	
56,000	.007667	.001334	.....	.....	
91,920	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	91,920
Elastic limit per square inch of original section	do...	51,000
Elongation per inch after rupture	inch..	.24
Elongation per inch under strain at elastic limit	do...	.001667
Reduction in diameter at point of rupture	do...	.174
Reduction in area after rupture, per cent of original section		52.2
Position of rupture		1".41 from neck
Character of broken surface		silky
Elongation of inch sections		".14, ".38, ".20

JACKET.

No. 7461.

Marks, $\frac{22433\ B_1}{B\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3."

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000183	.000133	0.	0.	
10,000	.000833	.000650	.....	.....	
20,000	.000700	.000867	.....	.....	
30,000	.001067	.000367	.....	.....	
40,000	.001400	.000333	0.	0.	
46,000	.001633	.000233	0.	0.	
50,000	.001733	.000100	.....	.....	
55,000	.001933	.000200	.....	.....	
57,000	.002000	.000067	.....	.....	
58,000	.002033	.000033	.....	.....	
59,000	.002100	.000067	.....	.....	Elastic limit.
60,000	.006633	.004533	.....	.....	
61,000	.007167	.000534	.....	.....	
62,000	.008400	.001233	.....	.....	
63,000	.009033	.000633	.....	.....	
64,000	.010267	.001234	.....	.....	
97,120	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	97,120
Elastic limit per square inch of original section	do...	59,000
Elongation per inch after rupture	inch..	.21
Elongation per inch under strain at elastic limit	do...	.002100
Reduction in diameter at point of rupture	do...	.174
Reduction in area after rupture, per cent of original section		52.2
Position of rupture		".95 from neck
Character of broken surface		silky
Elongation of inch sections		".37*, ".14, ".12

Hoop.

No. 7450.

Marks, $\frac{21900\ B_2}{B\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000300	.000167	.....	.....	
20,000	.000667	.000367	.....	.....	
30,000	.001000	.000333	.....	.....	
40,000	.001367	.000367	.....	.....	
45,000	.001500	.000133	0.	0.	
50,000	.001733	.000233	0.	0.	
58,000	.002033	.000300	.....	.....	
59,000	.002067	.000034	.....	.....	Elastic limit.
60,000	.005000	.002933	.....	.....	
61,000	.005833	.000833	.....	.....	
62,000	.006667	.000834	.....	.....	
63,000	.007267	.000600	.....	.....	
64,000	.008333	.001066	.....	.....	
106,800	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	106,800
Elastic limit per square inch of original section	do...	59,000
Elongation per inch after rupture	inch..	.19
Elongation per inch under strain at elastic limit	do...	.002067
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture		1".1 from neck
Character of broken surface		silky, cup shaped
Elongation of inch sections		".11, ".20 ".26*

BREECHBLOCK.

No. 7447.

Marks, $\frac{22349\ B_6}{T,\ M}$
Diameter, ".505.
Sectional area, .20 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00035	.00025	.....	.....	
20,000	.00065	.00030	.....	.....	
30,000	.00100	.00035	.....	.....	
40,000	.00135	.00035	0.	0.	
45,000	.00155	.00020	.....	.....	
50,000	.00175	.00020	.....	.....	
51,000	.00185	.00010	.....	.....	Elastic limit.
52,000	.00950	.00765	.....	.....	
53,000	.01015	.00065	.....	.....	
54,000	.01070	.00055	.....	.....	
55,000	.01150	.00080	.....	.....	
56,000	.01250	.00100	.....	.....	
97,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	97,000
Elastic limit per square inch of original section	do...	51,000
Elongation per inch after rupture	inch..	.23
Elongation per inch under strain at elastic limit	do...	.00185
Reduction in diameter at point of rupture	do...	.125
Reduction in area after rupture, per cent of original section		43.3
Position of rupture		".8 from neck
Character of broken surface		silky
Elongation of inch sections		".32*, ".14

TABULATION OF TENSION SPECIMENS FROM 6-INCH R. F. GUNS.

STEMS OF SPECIMENS FROM TUBES AND BREECHBLOCK 2" LONG, ".505 DIAMETER; FROM JACKETS AND HOOP 3" LONG, ".564 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
7448	Tube ...	Middle .	50,000	98,000	20.5	40.3	Granular, 60 per cent; silky, 40 per cent.	Muzzle end.
7449	....do ...	....do ...	51,000	93,250	14.5	20.5	Granular, a belt of flaky metal across surface.	Do.
7444	Jacket..	Outside.	53,000	99,680	20.0	44.6	Silky.....	Do.
7445	....do ...	....do ...	51,000	91,920	24.0	52.2	.....do.....	Do.
7461	....do ...	Middle .	59,000	97,120	21.0	52.2	.....do.....	Breech end.
7450	Hoop ...	....do ...	59,000	108,800	19.0	44.6	Silky, cup shaped....	Do.
7447	Breech-block.	Middle .	51,000	97,000	23.0	43.3	Silky.....	

10-INCH STEEL B. L. RIFLES.

SPECIMENS FROM TUBES, JACKETS, HOOPS, AND BREECHBLOCKS.

TUBE.

No. 7470.

Marks, $\frac{20633\ B_1}{M\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000833	.000200	.....	.....	
20,000	.000667	.000334	.....	.....	
30,000	.001000	.000333	.....	.....	
35,000	.001133	.000133	0.	0.	
40,000	.001333	.000200	0.	0.	
45,000	.001467	.000134	.....	.....	
46,000	.001533	.000066	.....	.....	
47,000	.001600	.000067	.....	.....	Elastic limit.
48,000	.002100	.000500	.....	.....	
49,000	.003167	.001067	.....	.....	
50,000	.006000	.002833	.....	.....	
51,000	.006333	.000333	.....	.....	
52,000	.007167	.000834	.....	.....	
53,000	.007833	.000666	.....	.....	
90,320	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	90,320
Elastic limit per square inch of original section	do...	47,000
Elongation per inch after rupture	inch..	.193
Elongation per inch under strain at elastic limit	do...	.001600
Reduction in diameter at point of rupture	do...	.104
Reduction in area after rupture, per cent of original section		33.5
Position of rupture		".90 from neck
Character of broken surface		granular 80 per cent, flaky 20 per cent
Elongation of inch sections		".14, ".17, ".27*

JACKET.

No. 7446.

Marks, $\frac{10805\ B_2}{B\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3."

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
20,000	.000633	.000333	.....	.....	
30,000	.000967	.000334	.....	.....	
35,000	.001133	.000166	0.	0.	
40,000	.001300	.000167	.....	.....	
42,000	.001367	.000067	0.	0.	
44,000	.001500	.000133	.....	.....	Elastic limit.
45,000	.003500	.002000	.....	.....	
46,000	.006000	.002500	.....	.....	
47,000	.006367	.000367	.....	.....	
48,000	.007467	.001100	.....	.....	
49,000	.008233	.000766	.....	.....	
86,800	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	86,800
Elastic limit per square inch of original section	do...	44,000
Elongation per inch after rupture	inch..	.23
Elongation per inch under strain at elastic limit	do...	.001500
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture		".9 from neck
Character of broken surface		silky
Elongation of inch sections		".37*, ".21, ".11

JACKET.

No. 7467.

Marks, $\frac{29122\ B_1}{M\ T_2\text{-}M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000333	.000200	.....	.....	
20,000	.000667	.000334	.....	.....	
30,000	.001033	.000366	.....	.....	
35,000	.001200	.000167	0.	0.	
40,000	.001400	.000200	.....	.....	
42,000	.001467	.000067	0.	0.	
50,000	.001767	.000300	.....	.....	
57,000	.002033	.000266	.....	.....	Elastic limit.
58,000	.002267	.000234	.....	.....	
59,000	.009267	.007000	.....	.....	
60,000	.010000	.000733	.....	.....	
61,000	.010933	.000933	.....	.....	
62,000	.011667	.000734	.....	.....	
92,320	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	92,320
Elastic limit per square inch of original section	do...	57,000
Elongation per inch after rupture	inch..	.22
Elongation per inch under strain at elastic limit	do...	.002033
Reduction in diameter at point of rupture	do...	.164
Reduction in area after rupture, per cent of original section		49.7
Position of rupture		at the middle of the stem
Character of broken surface		silky
Elongation of inch sections		".14, ".39, ".13

Hoop.

No. 7465.

Marks, $\overset{11241\ B_2}{B\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000333	.000200	.....	.....	
20,000	.000667	.000334	.....	.....	
30,000	.001033	.000366	.....	.....	
40,000	.001367	.000334	.....	.....	
45,000	.001567	.000200	0.	0.	
50,000	.001700	.000133	0.	0.	
60,000	.002100	.000400	.....	.....	Elastic limit.
61,000	.002233	.000133	.....	.....	
62,000	.005000	.002767	.....	.....	
63,000	.006067	.001067	.....	.....	
64,000	.007067	.001000	.....	.....	
65,000	.007833	.000766	.....	.....	
101,680	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	101,680
Elastic limit per square inch of original section	do...	60,000
Elongation per inch after rupture	inch..	.20
Elongation per inch under strain at elastic limit	do...	.002100
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture		".95 from neck
Character of broken surface		silky 60 per cent, granular 40 per cent
Elongation of inch sections		".11, ".17, ".32*

BREECHBLOCK.

No. 7464.

Marks, $\frac{17522\ B_8}{T_1\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3."

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive Permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
20,000	.000667	.000367	.....	.....	
30,000	.001000	.000333	.....	.....	
40,000	.001367	.000367	0.	0.	
46,000	.001600	.000233	.000033	.000033	
47,000	.001667	.000067	.....	.....	
48,000	.001733	.000066	.....	.....	Elastic limit.
49,000	.002000	.000267	.....	.....	
50,000	.003267	.001267	.....	.....	
51,000	.004067	.000800	.....	.....	
52,000	.004600	.000533	.....	.....	
53,000	.005133	.000533	.....	.....	
97,640	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	97,640
Elastic limit per square inch of original section	do...	48,000
Elongation per inch after rupture	inch..	.187
Elongation per inch under strain at elastic limit	do...	.001733
Reduction in diameter at point of rupture	do...	.104
Reduction in area after rupture, per cent of original section		33.5
Position of rupture		1".4 from neck
Character of broken surface	silky 40 per cent, fine granular 60 per cent; opened cracks in stem in vicinity of place of fracture.	
Elongation of inch sections		".18, ".25*, ".13

TABULATION OF TENSION SPECIMENS FROM 10-INCH STEEL B. L. RIFLES.

STEMS 3" LONG, ".564 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
7470	Tube	Middle	47,000	90,320	19.3	33.5	Granular, 80 per cent; flaky, 20 per cent.	Muzzle end.
7446	Jacket.....	...do...	44,000	86,800	23.0	44.6	Silky.....	Breech end.
7467	.....do.....	...do...	57,000	92,320	22.0	49.7	.....do.....	Muzzle end.
7465	Hoop	...do...	60,000	101,680	20.0	44.6	Silky, 60 per cent; granular, 40 per cent.	Breech end.
7464	Breechblock.	...do...	48,000	97,640	18.7	33.5	Silky, 40 per cent; fine granular, 60 per cent.	

12-INCH STEEL B. L. RIFLES.

SPECIMENS FROM TUBES, JACKETS, HOOPS, AND BREECHBLOCKS.

TUBE.

No. 7454.

Marks, $^{12\ R_{B}\ T}_{B\ T_{1}\ O}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
20,000	.000633	.000333	.....	.....	
30,000	.000967	.000334	.....	.....	
35,000	.001133	.000166	0.	0.	
40,000	.001367	.000234	.000033	.000033	
47,000	.001667	.000300	.....	.....	
48,000	.001733	.000066	.....	.....	
49,000	.001767	.000034	.....	.....	Elastic limit.
50,000	.001867	.000100	.....	.....	
51,000	.002000	.000133	.....	.....	
52,000	.002400	.000400	.....	.....	
53,000	.002733	.000333	.....	.....	
54,000	.003300	.000867	.....	.....	
55,000	.004033	.000733	.....	.....	
56,000	.005167	.000834	.....	.....	
89,160	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	89,160
Elastic limit per square inch of original section	do...	49,000
Elongation per inch after rupture	inch..	.177
Elongation per inch under strain at elastic limit	do...	.001767
Reduction in diameter at point of rupture	do...	.164
Reduction in area after rupture, per cent of original section		49.7
Position of rupture		".75 from neck
Character of broken surface		silky
Elongation of inch sections		".06, ".11, ".36*

TUBE.

No. 7463.

Marks, $\frac{24269\ B}{M\ T,\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
20,000	.000633	.000333	.....	.....	
30,000	.001000	.000367	.....	.....	
35,000	.001167	.000167	0.	0.	
40,000	.001367	.000200	0.	0.	
45,000	.001567	.000200	.....	.....	
47,000	.001667	.000100	.....	.....	Elastic limit.
48,000	.006833	.005166	.....	.....	
49,000	.007600	.000767	.....	.....	
50,000	.008333	.000733	.....	.....	
51,000	.009000	.000667	.....	.....	
52,000	.010000	.001000	.....	.....	
53,000	.010733	.000733	.....	.....	
87,200	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	87,200
Elastic limit per square inch of original section	do....	47,000
Elongation per inch after rupture	inch..	.233
Elongation per inch under strain at elastic limit	do...	.001667
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture		1".25 from neck
Character of broken surface		silky
Elongation of inch sections		".26, ".29*, ".15

JACKET.

No. 7451.

Marks, $\frac{12\ R_{es}\ J}{M\ T_1\ O}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000067	.000067	0.	0.	
10,000	.000267	.000200	.....	.....	
20,000	.000600	.000333	.....	.....	
30,000	.000933	.000333	.....	.....	
35,000	.001100	.000167	0.	0.	
40,000	.001267	.000167	.....	.....	
42,000	.001333	.000066	0.	0.	
50,000	.001667	.000334	.....	.....	
51,000	.001733	.000066	.....	.....	Elastic limit.
52,000	.001867	.000134	.....	.....	
53,000	.001967	.000100	.....	.....	
54,000	.002167	.000200	.....	.....	
55,000	.002800	.000633	.....	.....	
56,000	.004667	.001867	.....	.....	
93,600	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	93,600
Elastic limit per square inch of original section	do...	51,000
Elongation per inch after rupture	inch..	.17
Elongation per inch under strain at elastic limit	do...	.001733
Reduction in diameter at point of rupture	do...	.144
Reduction in area after rupture, per cent of original section		44.6
Position of rupture		".70 from neck
Character of broken surface		silky, trace of granulation
Elongation of inch sections		".09, ".11, ".31*

JACKET.

No. 7460.

Marks, $\frac{24446\ B}{M\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000300	.000167	.....	.....	
20,000	.000667	.000367	.....	.....	
30,000	.001000	.000333	.....	.....	
35,000	.001167	.000167	0.	0.	
40,000	.001367	.000200	.....	.....	
42,000	.001433	.000066	0.	0.	
45,000	.001533	.000100	.....	.....	
50,000	.001700	.000167	.....	.....	
51,000	.001733	.000033	.....	.....	Elastic limit.
52,000	.009333	.007600	.....	.....	
53,000	.009900	.000567	.....	.....	
54,000	.010667	.000767	.....	.....	
55,000	.011367	.000700	.....	.....	
56,000	.012333	.000966	.....	.....	
57,000	.012967	.000634	.....	.....	
91,920	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	91,920
Elastic limit per square inch of original section	do...	51,000
Elongation per inch after rupture	inch..	.237
Elongation per inch under strain at elastic limit	do...	.001733
Reduction in diameter at point of rupture	do...	.154
Reduction in area after rupture, per cent of original section		47.2
Position of rupture		1".40 from neck
Character of broken surface		silky
Elongation of inch sections		".14, ".35*, ".22

JACKET.

No. 7466.

Marks, $\frac{22402\ B}{M\ T_1\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, .3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000333	.000200			
20,000	.000667	.000334			
30,000	.001000	.000333			
35,000	.001133	.000133	0.	0.	
40,000	.001333	.000200			
42,000	.001367	.000034	0.	0.	
43,000	.001433	.000066			
44,000	.001500	.000067			
45,000	.001567	.000067			Elastic limit.
46,000	.002333	.000766			
47,000	.004167	.001834			
48,000	.005100	.000933			
49,000	.005667	.000567			
50,000	.006767	.001100			
91,160					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	91,160
Elastic limit per square inch of original section	do...	45,000
Elongation per inch after rupture	inch..	.167
Elongation per inch under strain at elastic limit	do...	.001567
Reduction in diameter at point of rupture	do...	.094
Reduction in area after rupture, per cent of original section		30.6
Position of rupture		1".2 from neck
Character of broken surface		granular, silky spot at the circumference
Elongation of inch sections		".17, ".23*, ".10

Hoop.

No. 7462.

Marks, $\frac{25594\ B_2}{M\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200	.....	.....	
20,000	.000667	.000367	.....	.....	
30,000	.001033	.000366	.....	.....	
40,000	.001367	.000334	.....	.....	
45,000	.001533	.000166	0.	0.	
50,000	.001700	.000167	0.	0.	
60,000	.002033	.000333	.....	.....	
62,000	.002100	.000067	.....	.....	
63,000	.002167	.000067	.....	.....	Elastic limit.
64,000	.002500	.000333	.....	.....	
65,000	.005333	.002833	.....	.....	
66,000	.007267	.001934	.....	.....	
67,000	.007833	.000566	.....	.....	
68,000	.009000	.001167	.....	.....	
102,800	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	102,800
Elastic limit per square inch of original section	do...	63,000
Elongation per inch after rupture	inch..	.197
Elongation per inch under strain at elastic limit	do...	.002167
Reduction in diameter at point of rupture	do...	.164
Reduction in area after rupture, per cent of original section		49.7
Position of rupture		1".22 from neck
Character of broken surface		silky
Elongation of inch sections		".11, ".23, ".25*

BREECHBLOCK.

No. 7453.

Marks, $\frac{24564\ B.}{M\ T_2\ M}$
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000367	.000234	.....	.....	
20,000	.000767	.000400	.....	.....	
30,000	.001133	.000366	.....	.....	
35,000	.001333	.000200	.000033	.000033	
40,000	.001500	.000167	.000033	0.	
50,000	.001933	.000433	.....	.....	
54,000	.002133	.000200	.....	.....	
55,000	.002200	.000067	.....	.....	Elastic limit.
56,000	.005833	.003633	.....	.....	
57,000	.010167	.004334	.....	.....	
58,000	.011333	.001166	.....	.....	
59,000	.012167	.000834	.....	.....	
60,000	.014333	.002166	.....	.....	
87,200	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	87,200
Elastic limit per square inch of original section	do...	55,000
Elongation per inch after rupture	inch..	.227
Elongation per inch under strain at elastic limit	do...	.002200
Reduction in diameter at point of rupture	do...	.134
Reduction in area after rupture, per cent of original section		41.9
Position of rupture		1 ".25 from neck
Character of broken surface		silky
Elongation of inch sections		".24, ".32[a] ".12

TABULATION OF TENSION SPECIMENS FROM 12-INCH STEEL B. L. RIFLES.

STEMS 3" LONG, ".564 DIAMETER.

No. of test.	Position in gun.	Location of specimens.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Remarks.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*		
7454	Tube	Outside.	49,000	89,160	17.7	49.7	Silky.....	Breech end.
7463	.....do	Middle.	47,000	87,200	23.8	44.6	.....do.....	Muzzle end.
7451	Jacket.....	Outside.	51,000	93,600	17.0	44.6	Silky, trace of granulation.	Do.
7460	.....do	Middle.	51,000	91,920	23.7	47.2	Silky.....	Do.
7466	.....do	....do...	45,000	91,160	16.7	30.6	Granular, silky spot at circumference.	Do.
7462	Hoop	....do...	63,000	102,800	19.7	49.7	Silky.....	Do.
7453	Breech block.	....do...	55,000	87,200	22.7	41.9	.....do.....	Do.

16-INCH STEEL B. L. RIFLE.

SPECIMEN FROM FORGING FROM WATERVLIET ARSENAL.

No. 7442.

16″ Rifle Forging.

Diameter, ″.505.
Sectional area, .20 square inch.
Gauged length, 1″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0001	0.	
10,000	.0002	.....	
20,000	.0004	.....	
30,000	.0006	0.	
40,000	.0011	.....	
50,000	.0013	.....	
60,000	.0016	.....	
65,000	.0018	.....	
70,000	.0020	.....	
80,000	.0023	.....	
82,000	.0024	.....	Elastic limit, approximate, not well defined.
83,000	.0026	.....	
84,000	.0030	.....	
85,000	.0032	.....	
86,000	.0034	.....	
87,000	.0038	.....	
88,000	.0040	.....	
89,000	.0042	.....	
90,000	.0047	.0013	
91,000	.0052	.....	
92,000	.0057	.....	
94,000	.0062	.....	
96,000	.0072	.....	
98,000	.0081	.....	
100,000	.0091	.....	
102,000	.0101	.....	
104,000	.0112	.....	
113,400	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	113,400
Elastic limit per square inch of original section, approximate	do...	82,000
Elongation per inch after rupture	inch..	.02
Elongation per inch under strain at elastic limit	do...	.0024
Reduction in diameter at point of rupture	do...	.005
Reduction in area after rupture, per cent of original section		1.8
Position of rupture		
Character of broken surface		fine granular, radiating from a point in the circumference
Elongation of inch section		″.02

RETRACTION AND BUFFER BRACKET HOOKS FOR 10-INCH BARBETTE CARRIAGE.

STEEL CASTINGS.

RETRACTION HOOK.

Measurements for distortion of hook taken from point of hook to fixed block in testing machine.

Applied loads.	Distortion of hook.	Applied loads.	Distortion of hook.
Pounds.	*Inch.*	*Pounds.*	*Inch.*
1,000	0.	16,000	.21
5,000	.08	17,000	.25
10,000	.10	18,000	.28
1,000	.02	19,000	.32
15,000	.19	20,000	.38
1,000	.08	1,000	.22

BUFFER BRACKET.

1,000	0.	18,000	.40
5,000	.08	19,000	.43
10,000	.19	20,000	.52
15,000	.30	20,000	.57 after 5 minutes.
1,000	.11	20,000	.58 after 10 minutes.
16,000	.32	1,000	.34
17,000	.35		

A part of the apparent distortion of the hook is attributed to the partial shearing of the 1-inch bolts securing the bracket to the testing fixture.

PISTON RODS AND RETRACTION ROPES.

Piston Rods.

PROOF STRESSES APPLIED TO PISTON RODS FOR GUN CARRIAGES.

Description.	Tensile stress applied.
	Pounds.
75-millimeter Vicker-Maxim mountain gun carriage	12,500
15-pounder Driggs-Seabury R. F. gun carriage	131,966
5-inch R. F., B. L. rifle carriage	100,000
8-inch disappearing carriage, model 1896	72,000
10-inch disappearing carriage	125,000
12-inch disappearing carriage	150,000
12-inch barbette carriage	279,128

Wire Retraction Ropes.

PROOF STRESSES APPLIED TO WIRE RETRACTION ROPES FOR GUN CARRIAGES.

Description.	Tensile stress applied.
	Pounds.
¼-inch steel wire retraction ropes with conical sockets, for 8-inch disappearing carriages	7,080
$\frac{5}{16}$-inch steel wire retraction ropes with conical sockets, for 10-inch disappearing carriages	8,800
⅜-inch steel wire retraction ropes with conical sockets, for 12-inch disappearing carriages	15,000

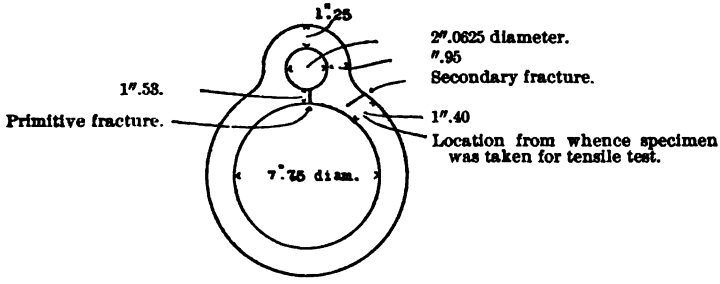
RECOIL CYLINDER, 12-INCH MORTAR CARRIAGE.

Steel from fractured casting from Fort Preble, Me.
Specimen taken longitudinally near secondary fracture.
Gauged length, 3″.

No. of test.	Diameter.	Sectional area.	Elastic limit.		Ultimate strength.		Elongation in 8 inches.		Contraction of area.
			Total.	Per square inch.	Total.	Per square inch.			
10481	*Inch.* 0.564	*Square inch.* 0.25	*Pounds.* 7,300	*Pounds.* 29,200	*Pounds.* 16,950	*Pounds.* 67,800	*Inch.* 0.90	*Per cent.* 30	*Per cent.* 27.4

Appearance of fracture.....oblique; silky and granular metal miter mingled.
Elongation of inch sections.....″.25, ″.38, ″.27

DESCRIPTION OF FRACTURES IN THE CASTING.



The primitive fracture, in the wall between the main cylinder and the auxiliary, presented a granular appearance, radiating from spongy metal near the surface of the bore of the main cylinder. The spongy metal extended over a length of 18″±, and at its maximum, was ″.85 deep from the surface of the bore, thus leaving about ″.68 thickness of sound metal beyond, at the worst place. There were several small, spongy spots in the surface of the bore in this vicinity, ranging in diameter from ″.01 to ″.02.

A secondary fracture was formed at the junction of the two cylinders, extending inward from the exterior surface of the casting, in depth nearly, but not quite, reaching the surface of the bore. This fracture had its origin at a spongy spot about ″.35 deep, on the outside of the casting.

The tensile specimen was taken out longitudinally from the walls of the cylinder adjacent to the secondary fracture.

Reenforcing Plate, 12-inch Mortar Carriage.

Forged steel.
Gauged length, 5″.

No. of test.	Diameter.	Sectional area.	Elastic limit.		Ultimate strength.		Elongation in 5 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
			Total.	Per square inch.	Total.	Per square inch.						
	Inches.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per cent.*	*Sq. inch.*	*Per cent.*		
10491	1.009	.8	30,100	37,630	58,050	72,560	.91	18.2	.650	18.8	Silky, 20 per cent; granular, 80 per cent.	″.19*, ″.20, ″.19, ″.18, ″.15.

Metal for Steel Shells for High Explosives, from the U. S. Projectile Company.

Description of specimens: B_1 Drawn steel. Seven-inch steel shell for high explosives. B_2 and B_3 Rolled steel. Billet for 3″.2 shell for high explosives.

No. of test.	Mark on specimen.	Diameter.	Sectional area.	Elastic limit.		Ultimate strength.		Elongation in 2 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.	
				Total.	Per square inch.	Total.	Per square inch.							
		Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds*	*Inch.*	*Per cent.*	*Sq. inch.*	*Per cent.*		″	″
10424	B_1	.505	.20	8,900	44,500	21,550	107,750	.30	15.0	.159	20.5	Fine granular	.14*,	.16*
10425	B_2	.505	.20	[a] 13,200	66,000	27,500	137,500	.18	9.0	.159	20.5	do	.06,	.12*
10426	B_3	.505	.20	[a] 13,100	65,500	26,260	131,300	.19	9.5	.166	17.0	do	.07,	.12*

[a] Approximate.

STEEL SPECIMENS FROM BUREAU OF ORDNANCE, U. S. NAVY.

No. of test.	Mark on specimen.	Diameter.	Sectional area.	Elastic limit.		Ultimate strength.		Elongation in 2 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.	
				Total.	Per square inch.	Total.	Per square inch.							
		Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per cent.*	*Sq. inch.*	*Per cent.*		"	"
10433	B 11-1	.500	.196	6,900	35,200	17,650	90,050	.37	18.5	.139	29.1	Granular, 60 per cent; silky center, 40 per cent.	.13,	.24*
10434	B 1-2	.500	.196	6,950	35,460	17,540	89,490	.34	17.0	.132	32.7	Granular, 70 per cent; silky, 30 per cent..	.23*,	.11
10435	B 111-3	.500	.196	6,980	35,610	17,520	89,390	.34	17.0	.139	29.1	.....do	.11,	.23*

STEEL FOR YOKES

FROM THE

BUREAU OF ORDNANCE, UNITED STATES NAVY.

STEEL FOR YOKES.

No. 7439.

Marks, $\frac{B\ 1}{III}$
Diameter, ".500.
Sectional area, .196 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010			
20,000	.00060	.00040	0.	0.	
30,000	.00105	.00045	0.	0.	
35,000	.00120	.00015			Elastic limit.
36,000	.00340	.00220			
37,000	.00385	.00045			
38,000	.00450	.00065			
39,000	.00510	.00060			
40,000	.00565	.00055			
87,550					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	87,550
Elastic limit per square inch of original section	do...	35,000
Elongation per inch after rupture	inch..	.20
Elongation per inch under strain at elastic limit	do...	.00120
Reduction in diameter at point of rupture	do...	.080
Reduction in area after rupture, per cent of original section		29.1
Position of rupture		1".1 from neck
Character of broken surface		granular 60 per cent, silky 40 per cent
Elongation of inch sections		".23*, ".17

Steel for Yokes.

No. 7440.

Marks, $\frac{B\,2}{III}$
Diameter, ".500.
Sectional area, .196 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00020	.00010	.....	.....	
20,000	.00055	.00035	.....	.....	
30,000	.00100	.00045	0.	0.	
34,000	.00115	.00015	.....	.....	Elastic limit.
35,000	.00210	.00095	.....	.....	
36,000	.00300	.00090	.....	.....	
37,000	.00425	.00125	.....	.....	
38,000	.00510	.00085	.....	.....	
39,000	.00575	.00065	.....	.....	
40,000	.00660	.00085	.....	.....	
80,400	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	80,400
Elastic limit per square inch of original section	do...	34,000
Elongation per inch after rupture	inch..	.085
Elongation per inch under strain at elastic limit	do...	.00115
Reduction in diameter at point of rupture	do...	.040
Reduction in area after rupture, per cent of original section		15.3
Position of rupture		".75 from neck
Character of broken surface		granular, radiating from a dull, silky spot in the circumference
Elongation of inch sections		".10*, ".07

STEEL FOR YOKES.

No. 7441

Marks, $\frac{B\ 3}{III}$
Diameter, ".500."
Sectional area, .196 square inch.
Gauged length, 2".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.00010	.00010	0.	0.	
10,000	.00030	.00020	.....	.....	
20,000	.00060	.00030	.....	.....	
30,000	.00100	.00040	0.	0.	
34,000	.00115	.00015	.....	.....	Elastic limit.
35,000	.00140	.00025	.....	.....	
36,000	.00165	.00025	.....	.....	
37,000	.00590	.00425	.....	.....	
38,000	.00625	.00035	.....	.....	
39,000	.00660	.00035	.....	.....	
40,000	.00715	.00055	.....	.....	
85,700	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	85,700
Elastic limit per square inch of original section	do...	34,000
Elongation per inch after rupture	inch..	.19
Elongation per inch under strain at elastic limit	do...	.00115
Reduction in diameter at point of rupture	do...	.050
Reduction in area after rupture, per cent of original section		18.9
Position of rupture		".83 from neck
Character of broken surface		granular, 60 per cent; silky, 40 per cent
Elongation of inch sections		".17, ".21*

Tabulation of Tension Specimens from Steel for Yokes.

Gauged length, 2″.

No. of test.	Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Ultimate strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Inch.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*		″ ″
7439	B_1, III....	.500	.196	35,000	87,550	20.0	29.1	Granular, 60 per cent; silky, 40 per cent	.23*, .17
7440	B_2, III....	.500	.196	34,000	80,400	8.5	15.8	Granular, radiating from a dull silky spot at the circumference	.10*, .07
7441	B_3, III....	.500	.196	34,000	85,700	19.0	18.9	Granular, 60 per cent; silky, 40 per cent	.17, .21*

Wrought Iron for Engineer Corps, U. S. Army.

MATERIAL FOR CRANE DERRICK.

No. of test.	Diameter.	Sectional area.	Elastic limit.		Ultimate strength.		Elongation.	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
			Total.	Per square inch.	Total.	Per square inch.					
	Inches.	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Per cent.*	*Sq. in.*	*Per cent.*		
10440	1.25	1.227	37,600	30,640	59,800	48,740	12.2	.650	47.0	Fibrous	″.09, ″.08, ″.09, ″.10, ″.10, ″.11, ″.09, ″.12, ″.19, ″.25.
10441	1.25	1.227	38,100	31,050	60,100	48,980	10.2	.650	47.0	.....do	″.11, ″.09, ″.10, ″.09, ″.10, ″.10, ″.10, ″.11, ″.11, ″.11.

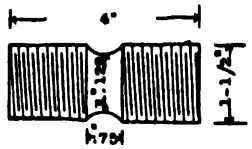
WROUGHT IRON, BENT, BUT STRAIGHTENED HOT BEFORE TESTING.

10527	1.0092	.80	25,300	31,630	43,320	54,150	26.7	.508	37.1	Fibrous; trace of granulation.	″.14, ″.33*, ″.33*.

CAST IRON AND PIG IRONS.

TENSION TESTS AND CHEMICAL ANALYSES.

CAST IRON FROM WATERTOWN ARSENAL FOUNDRY.



No. of test.	Description.	Chemical composition.								Tensile strength per square inch.	Fracture.	Specific gravity.
		Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.	Copper.			
		Total.	Graphitic.	Combined.								
										Pounds.		
6670	3" shell									28,080	Fine granular, gray	
6671	.....do									27,880	.....do	
6672	.....do									29,280	.....do	
6673	.....do									28,840	.....do	
6674	.....do									27,860	.....do	
6678	.....do	3.081	2.536	.545	.392	1.680	.074	.740		33,840	Fine granular, light gray	
6679	.....do									30,320	.....do	
6681	.....do									29,160	Fine granular, gray	
6683	.....do									27,520	.....do	
6684	.....do									29,440	.....do	
6685	6-pounder shell									23,620	.....do	
6688	.....do									25,600	.....do	
6689	.....do									29,750	.....do	
6690	.....do									26,000	.....do	
6696	.....do									28,360	.....do	7.105
6697	.....do									27,920	.....do	7.161
6685	15-pounder shell									23,620	.....do	
6688	.....do									25,600	.....do	
6689	.....do									29,750	.....do	
6690	.....do									26,000	.....do	
6696	.....do									28,360	.....do	7.105
6697	.....do									27,920	.....do	7.161
6700	.....do									27,120	.....do	7.043
6701	.....do									24,800	.....do	7.155
6702	.....do									25,100	.....do	7.161
6703	.....do									26,050	.....do	7.139

CAST IRON FROM WATERTOWN ARSENAL FOUNDRY—Continued.

No. of test.	Description.	Chemical composition.								Tensile strength per square inch.	Fractnre.	Specific gravity.
		Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.	Copper.			
		Total.	Graphitic.	Combined.								
										Pounds.		
6704	15-pounde: shell									25,200	Fine granular, gray	7.156
6705	do									29,700	do	7.224
6707	do									23,550	do	7.063
6761	do									33,650	Fine granular, light gray	7.031
6762	do									28,550	do	7.136
6766	do									28,300	do	7.134
6768	do									24,500	Granular, gray	7.046
6769	do									25,050	Fine granular, light gray	7.000
6665	12″ shell									27,980	Granular, light gray	
6687	do									27,700	Fine granular, light gray	
6691	do									28,650	Fine granular, light gray, granitic	
6708	do									28,010	do	7.254
6710	do									27,610	Fine granular, light gray	7.244
6712	do									27,280	do	7.263
6713	do									26,450	do	7.196
6715	do									27,500	do	7.296
6722	do									27,100	do	7.270
6726	do									26,990	Granular, gray, granitic	7.178
6727	do									25,150	Granular, gray	7.218
6728	do									28,340	Fine granular, gray	7.232
6730	do									28,800	Fine granular, light gray	7.232
6731	do									27,820	Fine granular, light gray, granitic	7.311
6732	do									28,690	Fine granular, light gray	
6733	do									27,850	do	7.278
6734	do									28,340	do	7.246
6736	do									30,110	do	7.274
6737	do									26,950	Granular, gray, mottled	7.232
6738	do									28,470	Granular, gray	7.090
6742	do									29,400	do	7.145
6744	do									32,330	Very fine granular, gray	7.217
6749	16″ shot									29,200	Fine granular, gray	7.291
6751	do									27,100	Granular, gray	7.148
6755	do									29,560	Fine granular, light gray	7.287
6759	do									24,750	Fine and coarse granular, light gray	7.059
6760	do									28,570	Fine granular, light gray	7.279
6767	do									26,700	Fine and coarse granular, gray, granitic	7.264

6765	.....do									30,440	Granular, gray		7.176
6770	.....do									28,600	Fine granular, light gray		7.206
6771	.....do									27,700	Coarse granular, gray		
6772	.....do									28,830	Fine and coarse granular, gray		7.219
6773	.....do									29,300	Granular, gray		7.222
6774	.....do									25,100	Fine and coarse granular, light gray		7.168
6775	.....do									28,900	Fine granular, light gray		7.185
6776	.....do									21,100	Coarse granular, gray		7.047
6777	.....do									30,510	Fine granular, light gray		7.160
6778	.....do									26,540	Granular, gray		7.163
6780	.....do									29,600	Fine granular, light gray		7.165
6706	12" barbette carriage									28,300	Fine granular, gray		7.083
6779	10" disappearing carriage									29,210	Fine granular, light gray		7.205
6729	12" disappearing carriage									26,050	Fine granular, light gray, dark spot at edge		7.064
6737	.....do									26,950	Granular, gray, mottled		7.232
6738	.....do									28,470	Granular, gray		7.090
6744	.....do									32,330	Very fine granular, gray		7.217
6752	.....do									30,500	Very fine granular, light gray, bright spots		7.199
6705	.....do									30,440	Granular, gray		7.176
6779	.....do									29,210	Fine granular, light gray		7.205
6744	12" mortar carriage									32,330	Very fine granular, gray		7.217

Pig Irons.

6763	Muirkirk pig									20,250	Fine and coarse granular, dark gray		7.107
6764	.....do									18,300	.....do		7.161

Miscellaneous.

6680	Track block									29,900	Fine granular, light gray, mottled		
6694	Specimen from fractured traversing intermediate bevel gear from Buffalo.									20,300	Fine granular, gray		
6695	.....do									19,250	.....do		

From Petersburg Iron Works.

6675	Projectile									28,350	Fine granular, light gray		7.269
6676	.....do									28,200	.....do		7.364
6750	8" and 12" shot and shell									28,680	Granular, light gray, granitic		
6753	.....do									26,520	.....do		
6754	.....do									29,080	.....do		

From City of Boston.

No. of test.	Description.	Chemical composition.								Tensile strength per square inch.	Fracture.	Specific gravity.
		Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.	Copper.			
		Total.	Graphitic.	Combined.								
										Pounds.		
6686	48" water pipe									19,300	Fine granular, gray	
6692	.....do									17,200	.....do	
6693	.....do									19,500	.....do	

For Calibration of Testing Machine at Works of Robert Poole & Son Co.

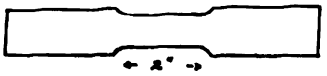
6740	No. 7—U 5503									24,410	Fine granular, gray	
6741	No. 7—L 5505									24,820	.....do	

Racer of 12" Mortar Carriage No. 125, Received from Fort Stevens.

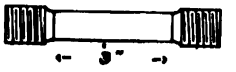
6716	From left side of center of racer, near fracture. Position of specimen, vertical.									31,150	Fine granular, light gray, mottled	7.215
6717	Same, except position horizontal.									30,330	.....do	7.260
6718	Same, position not given									28,230	.....do	7.246
6719	From right hand side of racer, near fracture.									26,700	.....do	7.288
6720	From right side of center of racer. Position of specimen, vertical.									27,090	.....do	7.259
6721	Same, except position horizontal.									30,000	.....do	7.249

BRONZE.

GUN CARRIAGE AND INGOT METAL.



BRONZE FROM ARSENAL FOUNDRY.



Marks.	Description.	Diameter.	Sectional area.	Tensile strength per square inch.	Elongation.	Contraction of area.	Fracture.
		Inches.	*Sq. inch.*	*Pounds.*	*Per ct.*	*Per ct.*	
9	Melts from phosphor-bronze ingot metal	.564	.25	43,200	15.5	15.0	Dull golden yellow.
11	75-millimeter mountain gun carriage	1.01×.313	.316	41,610	20.0	16.8	Lavender and golden yellow.
12	....do	1.02×.323	.329	37,080	9.5	12.8	Do.
13	....do	1.02×.315	.321	34,890	9.0	9.3	Do.
14	....do	.99×.275	.272	34,190	8.5	11.8	Do.
15	....do	.99×.275	.272	36,400	12.5	8.1	Do.
16	....do	1.01×.294	.297	33,060	9.0	15.8	Do.
17	....do	1.01×.284	.287	35,370	9.5	13.9	Do.
18	....do	1.02×.279	.285	34,040	8.5	11.6	Do.
N. M.	....do	1.01×.297	.300	59,000	7.0	11.3	Golden yellow, spongy spot.
R E M	....do	1.01×.31	.313	61,020	8.0	17.3	Lavender yellow, spongy spot.
N M P M B	....do	1.03×.32	.330	58,640	8.0	19.4	Golden yellow, spongy spot.
P R M B	....do	1.00×.30	.300	51,330	9.0	4.3	Do.
19	....do	1.01×.28	.283	32,160	7.0	14.1	Lavender and golden yellow.
20	....do	1.02×.27	.275	35,270	8.5	7.3	Do.
21	....do	1.02×.29	.296	33,610	6.5	9.8	Do.
22	....do	1.03×.33	.340	33,240	10.5	12.6	Do.
23	....do	1.04×.32	.333	30,540	9.5	6.9	Do.
24	....do	1.02×.30	.306	33,400	8.5	11.8	Do.
25	....do	1.00×.30	.300	32,430	5.5	12.7	Do.

BRONZE FROM OLD 12-POUNDER GUNS IN STORE AT WATERTOWN ARSENAL.

SPECIMENS FROM THE GUNS, AND RECAST METAL FROM THE SAME.

The metal from each of three 12-pounder bronze guns in store at Watertown Arsenal were examined for physical properties, and chemical analyses of the material were made.

For identification the guns were marked 1, 2, and 3. They were branded as follows:

No.	Legends.	
	Breech.	Muzzle, in part.
1	H. N. Hoopor & Co., No. 345	1,235 pounds C. C. 1864.
2	C. A. & Co., No. 166	1,235 pounds T. J. R. 1863.
3	Revere Copper Co., No. 440	1,230 pounds R. M. H. 1864.

The guns were cut into sections in the lathe and longitudinal segments taken out by the planer, and from the latter tensile specimens were turned down, from which the original properties of the metal were ascertained. Subsequently the metal from each of guns Nos. 1 and 2 were remelted and cast into ingots in iron molds, from whence tensile specimens were taken. Finally, metal from guns Nos. 2 and 3 were melted, tin and zinc added, and tensile specimens taken from the ingots which these mixtures furnished. Chemical analyses, specific gravity, and hardness determinations were made on the original metal taken directly from the guns.

It appears that the metal is approximately the so-called gun metal, 88, 10, and 2 mixture in the piece branded H. N. H. & Co.; a 90 Cu, 10 Sn mixture in the C. A. & Co. gun, and 90 Cu, 8 Sn, 2 Zn mixture in the R. C. Co. piece. In tensile strength the original metal from the guns ranged between the limits of 35,000 and 47,000 pounds per square inch; when recast, between 32,000 and 43,000 pounds per square inch, and after the addition of tin and zinc, 33,000 to 39,000 tensile strength was obtained.

CHEMICAL ANALYSES.

Gun No.	End.	Marks.	Copper.	Tin.	Zinc.	Iron.
1...	Breech	H. N. Hooper & Co	88.63	9.57	1.80	Trace.
1...	Muzzle	do	88.85	9.40	1.75	Trace.
2...	Breech	C. A. & Co	90.65	9.35	Trace.	.....
2...	Muzzle	do	90.50	9.50	Trace.	.....
3...	Breech	Revere Copper Co	90.90	7.60	1.50	.....
3...	Muzzle	do	90.77	7.75	1.48	.....

SPECIMENS TAKEN FROM LONGITUDINAL SLICES FROM THE GUN.

GUN NO. 1, BREECH END.

Diameter, 1".129.
Sectional area, 1.00 square inch.
Gauged length, 10".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00007	.00007	.....	.....	
3,000	.00014	.00007	.....	.....	
4,000	.00021	.00007	.....	.....	
5,000	.00028	.00007	0.	0.	
6,000	.00035	.00007	.....	.....	
7,000	.00042	.00007	.....	.....	
8,000	.00049	.00007	.....	.....	
9,000	.00056	.00006	.....	.....	
10,000	.00062	.00007	0.	0.	
11,000	.00070	.00008	.....	.....	
12,000	.00077	.00007	.....	.....	
13,000	.00085	.00008	.....	.....	
14,000	.00093	.00008	.....	.....	Elastic limit.
15,000	.00105	.00012	.00012	.00012	
16,000	.00122	.00017	.....	.....	
17,000	.00151	.00029	.....	.....	
18,000	.00200	.00049	.....	.....	
19,000	.00420	.00220	.....	.....	
19,000	.00500	.00080	.00385	.00373	
39,800	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	39,800
Elastic limit per square inch of original section	do...	14,000
Elongation per inch after rupture	inch..	.225
Elongation per inch under strain at elastic limit	do...	.00093
Reduction in diameter at point of rupture	do...	.119
Reduction in area after rupture, per cent of original section		19.9
Character of broken surface		uniform, dull lavender yellow
Elongation of inch sections		".21, ".22, ".22, ".23, ".23, ".22, ".23, ".27⁸, ".22, ".20

GUN NO. 1, MUZZLE END.

Diameter, 1".009.
Sectional area, .800 square inch.
Gauged length, 10".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00007	.00007	.....	.....	
3,000	.00013	.00006	.....	.....	
4,000	.00020	.00007	.....	.....	
5,000	.00029	.00009	0.	0.	
6,000	.00035	.00006	.....	.....	
7,000	.00042	.00007	.....	.....	
8,000	.00050	.00008	.....	.....	
9,000	.00057	.00007	.....	.....	
10,000	.00066	.00009	0.	0.	
11,000	.00072	.00006	.....	.....	
12,000	.00082	.00010	.....	.....	
13,000	.00090	.00008	.00001	.00001	
14,000	.00100	.00010	.....	.....	Elastic limit.
15,000	.00118	.00018	.00015	.00014	
16,000	.00145	.00027	.....	.....	
17,000	.00205	.00060	.....	.....	
18,000	.00500	.00295	.....	.....	
19,000	.01030	.00530	.....	.....	
20,000	.01600	.00570	.01458	.01443	
41,440	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	41,440
Elastic limit per square inch of original section	do...	14,000
Elongation per inch after rupture	inch..	.337
Elongation per inch under strain at elastic limit	do...	.00100
Reduction in diameter at point of rupture	do...	.159
Reduction in area after rupture, per cent of original section		29.1
Character of broken surface		uniform, golden yellow
Elongation of inch sections		".38, ".31, ".32, ".31, ".32, ".31, ".33, ".34, ".35, ".45, broke in the neck

Gun No. 2, Breech End.

Diameter, 1".129.
Sectional area, 1 square inch.
Gauged length, 10".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00007	.00007	.....	.....	
3,000	.00012	.00005	.....	.....	
4,000	.00019	.00007	.....	.....	
5,000	.00026	.00007	0.	0.	
6,000	.00031	.00005	.....	.....	
7,000	.00039	.00008	.....	.....	
8,000	.00045	.00006	.....	.....	
9,000	.00052	.00007	.....	.....	
10,000	.00060	.00008	0.	0.	
11,000	.00067	.00007	.....	.....	
12,000	.00074	.00007	.....	.....	
13,000	.00083	.00009	.....	.....	
14,000	.00091	.00008	.....	.....	Elastic limit.
15,000	.00102	.00011	.00009	.00009	
16,000	.00119	.00017	.....	.....	
17,000	.00142	.00023	.....	.....	
18,000	.00180	.00038	.....	.....	
19,000	.00280	.00100	.....	.....	
20,000	.00410	.00130	.....	.....	
20,000	.00490	.00080	.00420	.00411	
43,800	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	43,800
Elastic limit per square inch of original section	do...	14,000
Elongation per inch after rupture	inch..	.312
Elongation per inch under strain at elastic limit	do...	.00091
Reduction in diameter at point of rupture	do...	.199
Reduction in area after rupture, per cent of original section		32.1
Character of broken surface		uniform, lavender yellow
Elongation of inch sections		".28, ".29, ".30, ".30 ".31, ".32, ".32, ".31, .31", ".33

GUN NO. 2, MUZZLE END.

Diameter, 1″.009.
Sectional area, .800 square inch.
Gauged length, 10″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00005	.00005	.....	.....	
3,000	.00011	.00006	.....	.....	
4,000	.00018	.00007	.....	.....	
5,000	.00024	.00006	0.	0.	
6,000	.00031	.00007	.....	.....	
7,000	.00038	.00007	.....	.....	
8,000	.00044	.00006	.....	.....	
9,000	.00051	.00007	.....	.....	
10,000	.00058	.00007	0.	0.	
11,000	.00064	.00006	.....	.....	
12,000	.00072	.00008	.....	.....	
13,000	.00080	.00008	.....	.....	
14,000	.00090	.00010	.....	.....	Elastic limit.
15,000	.00100	.00010	.00004	.00004	
16,000	.00115	.00015	.....	.....	
17,000	.00135	.00020	.....	.....	
18,000	.00176	.00041	.....	.....	
19,000	.00250	.00074	.....	.....	
20,000	.00390	.00140	.00273	.00269	
21,000	.00650	.00260	.....	.....	
22,000	.01000	.00350	.....	.....	
47,000	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	47,000
Elastic limit per square inch of original section	do...	14,000
Elongation per inch after rupture	inch..	.407
Elongation per inch under strain at elastic limit	do...	.00090
Reduction in diameter at point of rupture	do...	.179
Reduction in area after rupture, per cent of original section		82.4
Character of broken surface		uniform, dark yellow
Elongation of inch sections		″.41, ″.41, ″.42, ″.40, ″.40, ″.40, ″.40, ″.41, ″.38, ″.44*

Gun No. 3, Breech End.

Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00008	.00008	.....	.....	
3,000	.00015	.00007	.....	.....	
4,000	.00022	.00007	.....	.....	
5,000	.00029	.00007	0.	0.	
6,000	.00034	.00005	.....	.....	
7,000	.00041	.00007	.....	.....	
8,000	.00049	.00008	.....	.....	
9,000	.00054	.00005	.....	.....	
10,000	.00060	.00006	.00001−	.....	
11,000	.00067	.00007	.....	.....	
12,000	.00076	.00009	.00003	.00002+	
13,000	.00084	.00008	.....	.....	Elastic limit.
14,000	.00100	.00016	.....	.....	
15,000	.00118	.00018	.00030	.00027	
16,000	.00160	.00042	.....	.....	
17,000	.00220	.00060	.....	.....	
18,000	.00380	.00160	.....	.....	
19,000	.00700	.00320	.....	.....	
20,000	.01200	.00500	.01070	.01040	
43,070	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	43,070
Elastic limit per square inch of original section	do...	13,000
Elongation per inch after rupture	inch..	.428
Elongation per inch under strain at elastic limit	do...	.00084
Reduction in diameter at point of rupture	do...	.209
Reduction in area after rupture, per cent of original section		33.5
Character of broken surface		uniform, reddish yellow
Elongation of inch sections		″.41, ″.43, ″.42, ″.43, ″.51*, ″.45, ″.42, ″.43, ″.40, ″38

GUN NO. 3, MUZZLE END.

Diameter, 1".009.
Sectional area, .800 square inch.
Gauged length, 10".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00008	.00008	.....	.....	
3,000	.00014	.00006	.....	.....	
4,000	.00021	.00007	.....	.....	
5,000	.00029	.00008	0.	0.	
6,000	.00036	.00007	.....	.....	
7,000	.00042	.00006	.....	.....	
8,000	.00050	.00008	.....	.....	
9,000	.00057	.00007	.....	.....	
10,000	.00065	.00008	.00001	.00001	
11,000	.00071	.00006	.....	.....	
12,000	.00081	.00010	.00004	.00003	Elastic limit.
13,000	.00092	.00011	.....	.....	
14,000	.00108	.00016	.....	.....	
15,000	.00142	.00034	.00048	.00041	
16,000	.00200	.00058	.....	.....	
17,000	.00300	.00100	.....	.....	
18,000	.00500	.00200	.....	.....	
19,000	.00800	.00300	.....	.....	
20,000	.01400	.00600	.....	.....	
20,000	.01600	.00200	.....	.....	
20,000	.01700	.00100	.01645	.01597	
35,130	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	35,130
Elastic limit per square inch of original section	do...	12,000
Elongation per inch after rupture	inch..	.213
Elongation per inch under strain at elastic limit	do...	.00081
Reduction in diameter at point of rupture	do...	.159
Reduction in area after rupture, per cent of original section		29.1
Character of broken surface		reddish yellow, spongy spots
Elongation of inch sections		".20, ".18, ".21, ".19, ".19, ".20, ".20, ".31*, ".23, ".22

Gun No. 3, Breech End.

Diameter, 1″.129.
Sectional area, 1 square inch.
Gauged length, 10″.

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	.....	.....	Initial load.
2,000	.00008	.00008	.....	.....	
3,000	.00015	.00007	.....	.....	
4,000	.00022	.00007	.....	.....	
5,000	.00029	.00007	0.	0.	
6,000	.00034	.00006	.....	.....	
7,000	.00041	.00007	.....	.....	
8,000	.00049	.00008	.....	.....	
9,000	.00054	.00005	.....	.....	
10,000	.00060	.00006	.00001−	.....	
11,000	.00067	.00007	.....	.....	
12,000	.00076	.00009	.00003	.00002+	
13,000	.00084	.00008	.....	.....	Elastic limit.
14,000	.00100	.00016	.....	.....	
15,000	.00118	.00018	.00030	.00027	
16,000	.00160	.00042	.....	.....	
17,000	.00220	.00060	.....	.....	
18,000	.00380	.00160	.....	.....	
19,000	.00700	.00320	.....	.....	
20,000	.01200	.00500	.01070	.01040	
43,070	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section ..... pounds.
Elastic limit per square inch of original section ..... do.
Elongation per inch after rupture ..... inch.
Elongation per inch under strain at elastic limit ..... do.
Reduction in diameter at point of rupture ..... do.
Reduction in area after rupture, per cent of original section .....
Character of broken surface ..... uniform, reddish
Elongation of inch sections ..... ″.41, ″.43, ″.42, ″.43, ″.51*, ″.45, ″.42, ″

C, *ADDI-*

Diameter [illegible]
Specimen [illegible]
Gauge [illegible]

[illegible]					
[illegible]					
[illegible]					
[illegible]					

The metal from each of three 12-pounder bronze guns in store at Watertown Arsenal were examined for physical properties, and chemical analyses of the material were made.

For identification the guns were marked 1, 2, and 3. They were branded as follows:

No.	Legends.	
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3	Revere Copper Co., No. 440	1,280 pounds R. M. H. 1864.

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It appears that the metal is approximately the so-called gun metal, 88, 10, and 2 mixture in the piece branded H. N. H. & Co.; a 90 Cu, 10 Sn mixture in the C. A. & Co. gun, and 90 Cu, 8 Sn, 2 Zn mixture in the R. C. Co. piece. In tensile strength the original metal from the guns ranged between the limits of 35,000 and 47,000 pounds per square inch; when recast, between 32,000 and 43,000 pounds per square inch, and after the addition of tin and zinc, 33,000 to 39,000 tensile strength was obtained.

CHEMICAL ANALYSES.

Gun No.	End.	Marks.	Copper.	Tin.	Zinc.	Iron.
1	Breech	H. N. Hooper & Co	88.63	9.57	1.80	Trace.
1	Muzzle	do	88.85	9.40	1.75	Trace.
2	Breech	C. A. & Co	90.65	9.35	Trace.	.....
2	Muzzle	do	90.50	9.50	Trace.	.....
3	Breech	Revere Copper Co	90.90	7.60	1.50	.....
3	Muzzle	do	90.77	7.75	1.48	.....

EXTRUDED BRASS, FROM ANGLE BAR.

Specimens 10½" long.

No. of test.	Dimensions.		Sectional area.	Elastic limit.		Ultimate strength.		Elongation in 3 inches.		Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Width.	Thickness.		Total.	Per square inch.	Total.	Per square inch.						
	Inches.	*Inch.*	*Sq. inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Inch.*	*Per cent.*	*Sq. inch.*	*Per cent.*		
10,526	1.342	.182	.244	8,700	35,660	18,300	75,000	.37	12.3	.213	12.7	Golden yellow	″.12, ″.13, ″.12*.
	1.341	.180	.241	8,300	34,440	14,700	61,000	.11	3.7	.214	11.2	Golden yellow with two bright yellow spots. Broke in jaw.	″.04, ″.04, ″.03.

CHEMICAL ANALYSIS.

Copper	54.05
Zinc	45.77

COPPER CYLINDERS FOR PRESSURE GAUGES.

TARAGE TABLE FOR PRESSURE CYLINDERS FURNISHED WITH THE GOLAZ (FRENCH) APPARATUS.

Cylinders received from Frankford Arsenal.

Mean dimensions: Length, ".5110; diameter, ".3140.

Actual loads applied.	Total compressions.										Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
100	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
200	.0002	.0002	.0002	.0001	.0001	.0002	.0002	.0002	.0002	.0001	.0002	.0001
300	.0008	.0005	.0007	.0006	.0005	.0005	.0002	.0004	.0007	.0002	.0005	.0004
400	.0021	.0012	.0019	.0018	.0015	.0008	.0005	.0013	.0014	.0004	.0013	.0011
500	.0037	.0029	.0035	.0037	.0032	.0011	.0016	.0030	.0024	.0005	.0026	.0024
600	.0060	.0051	.0054	.0057	.0049	.0019	.0036	.0047	.0045	.0006	.0042	.0039
700	.0077	.0070	.0075	.0081	.0070	.0036	.0055	.0068	.0061	.0006	.0060	.0057
800	.0102	.0091	.0098	.0100	.0094	.0053	.0074	.0088	.0085	.0007	.0079	.0075
900	.0122	.0127	.0116	.0125	.0109	.0073	.0095	.0110	.0103	.0008	.0099	.0094
1,000	.0147	.0136	.0140	.0147	.0140	.0103	.0115	.0132	.0128	.0009	.0120	.0114
1,100	.0170	.0163	.0163	.0174	.0156	.0120	.0141	.0155	.0145	.0010	.0140	.0134
1,200	.0197	.0190	.0190	.0195	.0186	.0140	.0165	.0180	.0175	.0011	.0163	.0157
1,300	.0220	.0218	.0215	.0223	.0216	.0163	.0190	.0205	.0198	.0012	.0186	.0178
1,400	.0250	.0240	.0243	.0251	.0235	.0189	.0220	.0235	.0220	.0013	.0210	.0202
1,500	.0279	.0274	.0270	.0282	.0263	.0214	.0243	.0258	.0255	.0014	.0235	.0227
1,600	.0310	.0300	.0300	.0307	.0295	.0240	.0272	.0288	.0280	.0016	.0261	.0251
1,700	.0336	.0330	.0330	.0338	.0322	.0267	.0305	.0314	.0310	.0017	.0287	.0277
1,800	.0370	.0363	.0365	.0374	.0350	.0302	.0334	.0346	.0340	.0018	.0316	.0306
1,900	.0402	.0400	.0392	.0400	.0383	.0330	.0365	.0378	.0370	.0019	.0344	.0334
2,000	.0435	.0426	.0426	.0431	.0415	.0341	.0400	.0406	.0404	.0022	.0381	.0369
2,100	.0469	.0462	.0462	.0470	.0457	.0398	.0430	.0441	.0435	.0023	.0404	.0392
2,200	.0501	.0492	.0490	.0502	.0483	.0427	.0470	.0480	.0471	.0026	.0434	.0422
2,300	.0547	.0532	.0530	.0544	.0526	.0462	.0500	.0508	.0506	.0029	.0468	.0456
2,400	.0572	.0570	.0564	.0570	.0553	.0491	.0540	.0543	.0540	.0034	.0498	.0485
2,500	.0610	.0605	.0603	.0610	.0595	.0526	.0570	.0584	.0573	.0040	.0582	.0519
2,600	.0645	.0645	.0640	.0647	.0626	.0568	.0610	.0623	.0608	.0058	.0567	.0554
2,700	.0689	.0678	.0671	.0690	.0665	.0605	.0647	.0658	.0645	.0104	.0605	.0591
2,800	.0724	.0718	.0714	.0723	.0710	.0644	.0683	.0696	.0686	.0179	.0648	.0634
2,900	.0759	.0765	.0759	.0765	.0739	.0681	.0730	.0737	.0725	.0259	.0692	.0678
3,000	.0802	.0798	.0800	.0810	.0790	.0710	.0761	.0779	.0764	.0338	.0735	.0720
3,100	.0840	.0835	.0838	.0841	.0827	.0761	.0810	.0818	.0802	.0425	.0780	.0765
3,200	.0881	.0883	.0877	.0888	.0867	.0796	.0848	.0858	.0844	.0497	.0824	.0809
3,300	.0921	.0917	.0911	.0926	.0906	.0831	.0892	.0898	.0887	.0580	.0867	.0852
3,400	.0958	.0965	.0964	.0967	.0954	.0881	.0933	.0937	.0926	.0652	.0914	.0899
3,500	.1000	.1010	.1000	.1010	.0990	.0925	.0975	.0984	.0970	.0698	.0956	.0941
3,600	.1040	.1045	.1045	.1054	.1035	.0960	.1011	.1034	.1015	.0778	.1002	.0987
3,700	.1076	.1076	.1078	.1090	.1073	.1014	.1056	.1058	.1066	.0850	.1044	.1029
3,800	.1123	.1126	.1124	.1133	.1130	.1047	.1090	.1090	.1096	.0899	.1086	.1071
3,900	.1166	.1180	.1170	.1184	.1160	.1079	.1139	.1145	.1139	.0952	.1131	.1116
4,000	.1204	.1215	.1210	.1215	.1190	.1125	.1172	.1184	.1186	.1000	.1170	.1154
4,100	.1235	.1244	.1239	.1236	.1230	.1170	.1215	.1225	.1224	.1060	.1208	.1192
4,200	.1280	.1279	.1265	.1270	.1270	.1209	.1249	.1254	.1259	.1120	.1246	.1230
4,300	.1319	.1330	.1330	.1330	.1320	.1248	.1280	.1289	.1289	.1167	.1290	.1274
4,400	.1370	.1370	.1358	.1361	.1370	.1280	.1335	.1342	.1338	.1205	.1333	.1317
4,500	.1413	.1415	.1395	.1410	.1402	.1325	.1370	.1390	.1375	.1240	.1374	.1358
4,600	.1452	.1450	.1435	.1440	.1424	.1360	.1408	.1430	.1417	.1283	.1410	.1394
4,700	.1493	.1490	.1480	.1490	.1466	.1400	.1449	.1460	.1460	.1348	.1454	.1438
4,800	.1531	.1540	.1522	.1530	.1510	.1439	.1490	.1495	.1497	.1395	.1495	.1479
4,900	.1577	.1578	.1568	.1565	.1550	.1480	.1535	.1540	.1554	.1437	.1539	.1523
5,000	.1615	.1621	.1592	.1609	.1580	.1530	.1570	.1589	.1585	.1480	.1577	.1560
5,100	.1654	.1665	.1640	.1641	.1625	.1564	.1608	.1623	.1625	.1530	.1618	.1601
5,200	.1696	.1710	.1676	.1683	.1667	.1598	.1650	.1660	.1666	.1578	.1658	.1641
5,300	.1741	.1750	.1720	.1725	.1700	.1634	.1689	.1705	.1698	.1621	.1698	.1681
5,400	.1778	.1786	.1759	.1765	.1750	.1673	.1726	.1750	.1750	.1670	.1741	.1724
5,500	.1819	.1833	.1792	.1797	.1785	.1710	.1768	.1786	.1789	.1705	.1778	.1760
5,600	.1856	.1870	.1839	.1843	.1824	.1755	.1801	.1830	.1828	.1749	.1820	.1802
5,700	.1896	.1910	.1876	.1879	.1860	.1785	.1844	.1868	.1863	.1789	.1857	.1839
5,800	.1928	.1946	.1915	.1920	.1895	.1830	.1879	.1897	.1905	.1835	.1895	.1877
5,900	.1966	.1977	.1953	.1951	.1940	.1868	.1918	.1940	.1940	.1873	.1933	.1915
6,000	.2024	.2029	.1989	.1989	.1972	.1904	.1958	.1974	.1978	.1910	.1973	.1954
6,100	.2050	.2060	.2028	.2027	.2020	.1945	.1992	.2020	.2011	.1948	.2010	.1991
6,200	.2083	.2089	.2062	.2062	.2048	.1982	.2030	.2049	.2054	.1982	.2044	.2025
6,300	.2116	.2128	.2095	.2093	.2081	.2015	.2060	.2081	.2084	.2034	.2079	.2060
6,400	.2144	.2160	.2123	.2123	.2120	.2048	.2090	.2109	.2116	.2068	.2110	.2091
6,500	.2177	.2185	.2155	.2155	.2150	.2090	.2126	.2145	.2140	.2105	.2143	.2124
6,600	.2210	.2219	.2184	.2191	.2183	.2118	.2160	.2175	.2174	.2140	.2175	.2156
6,700	.2238	.2251	.2215	.2225	.2210	.2145	.2192	.2203	.2208	.2174	.2206	.2187
6,800	.2270	.2282	.2249	.2251	.2240	.2173	.2218	.2239	.2238	.2205	.2237	.2218
6,900	.2300	.2315	.2280	.2275	.2275	.2198	.2249	.2265	.2270	.2238	.2267	.2248
7,000	.2329	.2341	.2318	.2304	.2300	.2230	.2279	.2295	.2297	.2275	.2297	.2278
7,100	.2356	.2367	.2346	.2338	.2334	.2256	.2315	.2325	.2330	.2303	.2327	.2308

TARAGE TABLE FOR PRESSURE CYLINDERS, ETC.—Continued.

Actual loads applied.	Total compressions.											Mean corrected sets.
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Mean.	
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
7,200	.2384	.2400	.2370	.2378	.2358	.2286	.2341	.2363	.2357	.2330	.2357	.2338
7,300	.2415	.2425	.2397	.2400	.2389	.2318	.2367	.2385	.2385	.2354	.2384	.2365
7,400	.2438	.2454	.2420	.2426	.2416	.2345	.2396	.2409	.2413	.2384	.2410	.2391
7,500	.2462	.2480	.2449	.2450	.2440	.2374	.2420	.2443	.2440	.2414	.2437	.2417
7,600	.2489	.2508	.2476	.2472	.2469	.2398	.2452	.2464	.2466	.2445	.2464	.2444
7,700	.2516	.2529	.2502	.2502	.2492	.2425	.2474	.2487	.2491	.2473	.2489	.2469
7,800	.2541	.2550	.2529	.2531	.2515	.2451	.2505	.2515	.2511	.2496	.2514	.2494
7,900	.2567	.2573	.2552	.2550	.2542	.2477	.2530	.2535	.2533	.2520	.2538	.2518
8,000	.2590	.2595	.2577	.2575	.2561	.2503	.2551	.2559	.2561	.2551	.2562	.2541
8,100	.2611	.2622	.2595	.2600	.2584	.2525	.2574	.2585	.2584	.2570	.2585	.2564
8,200	.2633	.2649	.2619	.2621	.2610	.2545	.2595	.2609	.2605	.2590	.2608	.2587
8,300	.2654	.2675	.2642	.2644	.2630	.2574	.2623	.2631	.2630	.2616	.2632	.2611
8,400	.2675	.2695	.2665	.2665	.2652	.2597	.2653	.2654	.2653	.2644	.2655	.2634
8,500	.2697	.2716	.2686	.2689	.2675	.2620	.2668	.2676	.2683	.2665	.2678	.2657
8,600	.2719	.2734	.2709	.2710	.2700	.2641	.2687	.2695	.2703	.2689	.2699	.2678
8,700	.2740	.2750	.2735	.2725	.2720	.2660	.2710	.2715	.2722	.2714	.2719	.2698
8,800	.2760	.2770	.2752	.2744	.2740	.2683	.2729	.2737	.2745	.2734	.2739	.2718
8,900	.2777	.2792	.2770	.2765	.2755	.2708	.2749	.2756	.2764	.2761	.2760	.2739
9,000	.2796	.2813	.2793	.2782	.2777	.2729	.2774	.2780	.2782	.2775	.2780	.2759
9,100	.2817	.2831	.2811	.2809	.2800	.2750	.2790	.2800	.2804	.2796	.2801	.2780
9,200	.2834	.2851	.2832	.2828	.2818	.2768	.2810	.2823	.2822	.2813	.2820	.2799
9,300	.2852	.2871	.2849	.2844	.2838	.2787	.2823	.2847	.2840	.2830	.2838	.2817
9,400	.2869	.2890	.2870	.2864	.2855	.2807	.2846	.2861	.2863	.2851	.2858	.2837
9,500	.2887	.2910	.2890	.2877	.2875	.2825	.2867	.2875	.2881	.2870	.2876	.2855
9,600	.2903	.2926	.2906	.2900	.2887	.2846	.2885	.2890	.2897	.2888	.2893	.2872
9,700	.2924	.2941	.2921	.2919	.2908	.2865	.2902	.2908	.2919	.2908	.2912	.2891
9,800	.2940	.2957	.2937	.2934	.2930	.2885	.2919	.2926	.2931	.2929	.2929	.2908
9,900	.2956	.2970	.2958	.2946	.2948	.2902	.2934	.2945	.2947	.2944	.2945	.2924
10,000	.2970	.2989	.2974	.2976	.2965	.2918	.2952	.2960	.2960	.2960	.2962	.2940
10,100	.2986	.3005	.2990	.2985	.2976	.2934	.2970	.2972	.2975	.2976	.2977	.2955
10,200	.3001	.3019	.3002	.2998	.2994	.2947	.2987	.2985	.2998	.2990	.2992	.2970
10,300	.3017	.3024	.3020	.3018	.3009	.2962	.3003	.3005	.3015	.3010	.3008	.2986
10,400	.3030	.3046	.3037	.3030	.3026	.2979	.3019	.3021	.3030	.3023	.3024	.3002
10,500	.3046	.3060	.3052	.3049	.3043	.2995	.3035	.3039	.3044	.3039	.3040	.3018
10,600	.3060	.3075	.3068	.3061	.3056	.3015	.3051	.3055	.3059	.3056	.3056	.3034
10,700	.3074	.3093	.3082	.3077	.3070	.3030	.3068	.3069	.3070	.3074	.3071	.3049
10,800	.3068	.3105	.3100	.3090	.3084	.3047	.3083	.3080	.3085	.3085	.3085	.3063
10,900	.3103	.3123	.3115	.3102	.3098	.3059	.3098	.3095	.3100	.3100	.3099	.3077
11,000	.3117	.3136	.3125	.3124	.3112	.3070	.3111	.3110	.3114	.3119	.3114	.3092
11,100	.3130	.3148	.3138	.3132	.3126	.3080	.3126	.3120	.3127	.3130	.3126	.3104
11,200	.3141	.3160	.3154	.3146	.3140	.3095	.3138	.3135	.3144	.3141	.3139	.3117
11,300	.3155	.3174	.3165	.3156	.3153	.3114	.3149	.3149	.3158	.3160	.3153	.3131
11,400	.3170	.3189	.3179	.3170	.3166	.3126	.3169	.3161	.3168	.3174	.3167	.3145
11,500	.3184	.3200	.3191	.3182	.3180	.3140	.3180	.3175	.3180	.3184	.3180	.3158
11,600	.3198	.3215	.3205	.3198	.3192	.3155	.3190	.3188	.3193	.3194	.3193	.3171
11,700	.3208	.3229	.3218	.3215	.3204	.3172	.3200	.3200	.3206	.3209	.3206	.3184
11,800	.3221	.3240	.3233	.3225	.3218	.3186	.3215	.3215	.3219	.3221	.3219	.3197
11,900	.3232	.3250	.3244	.3235	.3233	.3195	.3228	.3230	.3232	.3232	.3231	.3209
12,000	.3250	.3259	.3253	.3244	.3244	.3208	.3240	.3239	.3244	.3249	.3243	.3220
12,100	.3254	.3270	.3265	.3256	.3256	.3220	.3250	.3250	.3258	.3257	.3253	.3230
12,200	.3265	.3283	.3277	.3272	.3267	.3232	.3263	.3260	.3267	.3268	.3265	.3242
12,300	.3276	.3296	.3291	.3284	.3278	.3244	.3275	.3273	.3276	.3281	.3277	.3254
12,400	.3289	.3305	.3303	.3294	.3291	.3254	.3287	.3284	.3290	.3294	.3289	.3266
12,500	.3300	.3316	.3312	.3304	.3300	.3265	.3296	.3294	.3300	.3305	.3299	.3276
12,600	.3310	.3327	.3320	.3315	.3311	.3276	.3307	.3305	.3318	.3316	.3310	.3287
12,700	.3320	.3335	.3335	.3327	.3320	.3286	.3318	.3319	.3324	.3328	.3321	.3298
12,800	.3330	.3346	.3345	.3336	.3330	.3297	.3330	.3329	.3335	.3336	.3331	.3308
12,900	.3341	.3358	.3354	.3353	.3341	.3308	.3340	.3338	.3346	.3347	.3343	.3320
13,000	.3351	.3370	.3366	.3363	.3352	.3320	.3353	.3345	.3356	.3359	.3354	.3331
13,100	.3361	.3380	.3375	.3373	.3363	.3330	.3360	.3355	.3370	.3368	.3364	.3341
13,200	.3370	.3390	.3385	.3380	.3373	.3339	.3369	.3369	.3380	.3375	.3373	.3350
13,300	.3380	.3398	.3394	.3389	.3381	.3350	.3378	.3379	.3389	.3383	.3382	.3359
13,400	.3389	.3406	.3403	.3397	.3392	.3359	.3389	.3388	.3396	.3391	.3391	.3368
13,500	.3398	.3418	.3412	.3406	.3401	.3369	.3398	.3396	.3405	.3402	.3401	.3378
13,600	.3409	.3428	.3422	.3416	.3412	.3380	.3408	.3406	.3414	.3414	.3411	.3388
13,700	.3418	.3436	.3431	.3424	.3421	.3390	.3420	.3414	.3423	.3424	.3420	.3397
13,800	.3425	.3445	.3440	.3433	.3431	.3396	.3430	.3424	.3435	.3434	.3429	.3406
13,900	.3485	.3456	.3449	.3442	.3440	.3405	.3439	.3434	.3445	.3444	.3439	.3416
14,000	.3444	.3465	.3458	.3454	.3446	.3417	.3445	.3441	.3456	.3452	.3448	.3425
14,100	.3450	.3472	.3469	.3460	.3455	.3427	.3454	.3451	.3466	.3461	.3457	.3434
14,200	.3458	.3479	.3478	.3470	.3465	.3436	.3463	.3458	.3472	.3469	.5465	.3442
14,300	.3467	.3485	.3489	.3478	.3475	.3444	.3475	.3466	.3483	.3477	.3474	.3451
14,400	.3476	.3493	.3495	.3485	.3483	.3450	.3484	.3475	.3490	.3488	.3482	.3459
14,500	.3484	.3502	.3502	.3491	.3490	.3460	.3492	.3485	.3498	.3498	.3490	.3467
14,600	.3493	.3512	.3510	.3500	.3500	.3470	.3505	.3494	.3505	.3510	.3500	.3477
14,700	.3500	.3523	.3520	.3512	.3510	.3475	.3514	.3502	.3515	.3516	.3509	.3486
14,800	.3508	.3530	.3527	.3521	.3518	.3484	.3522	.3510	.3523	.3524	.3517	.3494
14,900	.3517	.3537	.3535	.3527	.3525	.3490	.3528	.3520	.3529	.3529	.3524	.3501
15,000	.3529	.3545	.3544	.3537	.3534	.3498	.3536	.3533	.3537	.3540	.3533	.3509

HELICAL SPRINGS.

Helical Springs for Gun Carriages.

Compression tests of buffer springs for 75-millimeter R. F. mountain gun carriage.

DESCRIPTION OF ONE SPRING.

Free height ..... inches.. 25.80
Number of coils 45
Pitch ..... inch.. .596
Exterior diameter ..... inches.. 2.05
Interior diameter ..... do... 1.14 ←Interior.
Dimensions of ribbon ..... ".106 ".140

	Height.	Load sustained.	Remarks.
First spring:	*Inches.*	*Pounds.*	
First test	19.91	120	
	7.83	400	
	6.58	400	Spring jarred.
	9.92	300	
	9.98	300	Spring jarred.
	19.35	120	
	19.38	120	Spring jarred.
	25.73	0	
Second test	19.20	120	Testing attachment greased.
	15.12	200	Spring jarred continuously.
	9.94	300	
	7.00	380	
	9.90	300	
	15.10	200	
	19.32	120	
	25.73	0	
Second spring:			
First test	25.80	0	Spring jarred continuously.
	19.71	120	
	16.02	200	
	10.71	300	
	7.00	390	
	10.00	300	
	14.90	200	
	19.06	120	
	25.70	0	
Second test	19.34	120	
	15.49	200	
	10.42	300	
	7.00	380	
	9.89	300	
	14.85	200	
	18.94	120	
	25.70	0	
Third spring, extra spring furnished with carriage. Previously tested.	24.80	0	Spring jarred continuously.
	20.08	120	
	16.95	200	
	12.88	300	
	8.97	400	
	7.00	474	
	8.49	400	
	12.30	300	
	16.20	200	
	19.30	120	
	24.66	0	

DIMINSIONS OF THIRD SPRING, TAKEN AFTER TESTING.

Free height ..... inches.. 24.66
Number of coils 45
Pitch ..... inch.. .560
Exterior diameter ..... inches.. 2.00
Interior diameter ..... do.... 1.14 ←Interior.
Dimensions of ribbon ..... ".115 ".160

Compression test of a helical spring from a 75-millimeter R. F. mountain gun carriage, from Frankford Arsenal.

DESCRIPTION.

Free height ..... inches.. 24.93
Number of coils 43.5
Pitch ..... inch.. .609
Exterior diameter ..... inches.. 2.10
Interior diameter ..... do.... 1.13

Dimensions of ribbon ..... ″.109 ″.145 ← Interior.

Height.	Load sustained.	Remarks.
Inches.	*Pounds.*	
24.98	0	Testing attachment greased.
19.05	120	Spring and testing attachment jarred continuously to reduce frictional resistance.
15.77	200	
11.40	300	
7.20	400	
7.00	416	
11.00	300	
15.17	200	
18.98	120	
24.75	0	
24.79	0	After resting 10 minutes.
Spring loaded 100 times, closed down to a height of 7 inches and released to zero each time.		
24.50	0	
24.50	0	After resting 10 minutes.
19.05	120	Under test the spring deflected laterally and bore against the rods of the testing attachment. The frictional resistance was largely reduced by jarring.
15.70	200	
11.08	300	
7.38	400	
7.00	414	
10.75	300	
15.10	200	
18.80	120	
24.50	0	
18.80	120	
15.64	200	
11.15	300	
7.03	400	
7.00	408	
11.57	300	
15.66	200	
19.40	120	
24.48	0	
24.51	0	After resting 16 hours.

Compression tests of helical springs furnished by The Wm. D. Gibson Company.

Buffer springs for 75-millimeter R. F. mountain gun carriages.

DESCRIPTION OF FIRST SPRING.

Free height	inches..	32.60
Number of coils		53.75
Pitch	inch..	.628
Exterior diameter	inches..	2.18
Interior diameter	do...	1.10
Dimensions of ribbon		←Interior. ″.080 ″.110

	Height.	Load sustained.	Remarks.
	Inches.	*Pounds.*	
First spring	32.60	0	
	22.15	99	
	6.43	252	Closed down.
	21.20	100	
	32.38	0	
Second spring	32.43	0	54¼ coils.
	22.15	100	
	6.40	254	Closed down.
	21.05	100	
	31.99	0	

HELICAL SPRINGS, DOUBLE COIL, FOR 5-INCH R. F. GUN.

Six springs tested.

DESCRIPTION OF ONE SPRING.

Outside coil, left-hand spring:
- Exterior diameter ..... inches.. 4.90
- Diameter of bar ..... do... .69
- Height of spring unloaded ..... do... 21.80
- Distance between coils ..... do... .75
- Weight ..... 21 pounds 5 ounces.

Inside coil, right-hand spring:
- Exterior diameter ..... inches.. 3.40
- Diameter of bar ..... do... .50
- Height of spring unloaded ..... do... 20.00
- Distance between coils ..... do... .40
- Weight ..... 11 pounds 1.5 ounces.

	Height.	Load sustained.	Remarks.
First spring:	*Inches.*	*Pounds.*	
Outside coil	15.62	1,650	
	15.50	1,740	
	10.78	3,400	Closed down.
	16.50	1,470	
	14.70	1,650	
Inside coil	15.50	800	Sprung out of line so that it could not be closed down.
Outer and inner coils assembled and tested together.			
	15.50	2,360	
	11.09	4,400	Closed down.
	15.50	2,060	
	14.57	2,450	
In the following tests the outer and inner coils were assembled and tested together.			
Second spring	15.50	2,450	
	11.09	4,600	Closed down.
	14.95	2,450	
	15.50	2,180	
Third spring	15.50	2,430	
	10.89	4,550	Closed down.
	14.75	2,450	
	15.50	2,150	
Fourth spring	15.50	2,340	
	10.94	4,600	Closed down.
	14.85	2,450	
	15.50	2,070	
Fifth spring	15.87	2,450	
	15.50	2,640	
	10.94	4,700	Closed down.
	15.43	2,450	
	15.50	2,390	
Sixth spring	15.60	2,450	
	15.50	2,600	
	10.61	4,600	Closed down.
	14.55	2,450	
	15.50	2,110	

COUNTER RECOIL SPRINGS FOR 7-INCH MORTAR CARRIAGES.

COMPARISON OF OLD AND NEW STYLES OF SPRINGS.

NUMBER AND WEIGHT PER CARRIAGE.

Style.	Number for a carriage.	Weight.	
		Each.	Total.
		Pounds.	*Pounds.*
Old	10	8.75	87.5
New	4	18	72

DIMENSIONS.

Style.	Size of wire.	Diameters.		Distance between coils.	Number of coils.	Height.
		Exterior.	Interior.			
		Inches.	*Inches.*	*Inch.*		*Inches.*
Old	".55 by ".75	4.48	2.98	.66	7	7.1+
New	".68 diam.	5.00	3.63	.84	13¼	18.5±

SPECIFICATIONS, NEW SPRINGS.

Outside diameter of springs	inches..	5. ±0.06
Inside diameter of springs	do...	3.625±0.06
Height when compressed solid, not over	do...	9.5
Height when loaded with 1,200 pounds, not less than	do...	15.
Height when free, about	do...	18.325

Each spring to consist of a single coil of round bars and to be closed down solid, and to remain thus for sixty hours, at the end of which period it shall fulfill the requirements stated above. The temper to be drawn from the thin ends in each spring to obviate brittleness.

Compression Tests of Three Old Springs from 7-inch Mortar Carriages.

DESCRIPTION OF FIRST SPRING.

7 right-hand coils of rectangular cross section.
Size of wire ..... inch.. .55 by .75
Outside diameter of coil ..... inches.. 4.48
Inside diameter of coil ..... do... 2.98
Distance between coils ..... inch.. .66
Weight ..... 8 pounds 12 ounces

	Height.	Load.	Remarks.
	Inches.	*Pounds.*	
First spring	6.98	0	
	5.92	1,200	
	5.72	1,420	
	4.01	3,700	Closed down.
	5.72	1,280	
	5.82	1,200	
	6.96	0	
	5.90	1,200	
	5.72	1,380	
	4.01	3,500	Closed down.
	5.72	1,270	
	5.79	1,200	
	6.95	0	
Second spring	7.12	0	
	5.98	1,200	
	5.72	1,480	
	4.03	3,600	Closed down.
	5.72	1,330	
	5.85	1,200	
	7.10	0	
	5.94	1,200	
	5.72	1,430	
	4.08	3,600	Closed down.
	5.72	1,320	
	5.84	1,200	
	7.09	0	
Third spring	6.97	0	
	5.94	1,200	
	5.72	1,460	
	4.11	3,600	Closed down.
	5.72	1,340	
	5.83	1,200	
	6.96	0	
	5.92	1,200	
	5.72	1,430	
	4.11	3,500	Closed down.
	5.72	1,320	
	5.82	1,200	
	6.96	0	

HELICAL SPRINGS, DOUBLE COIL, FOR 10-INCH MORTAR CARRIAGES.

From lot of 12 springs received January 25, 1902.

DESCRIPTION OF ONE SPRING.

Outside coil, 6 coils, left-hand spring:

Exterior diameter	inches..	9.10
Interior diameter	do...	5.60
Diameter of bar	do...	1.75
Height of spring unloaded	do...	14.51
Distance between coils	do...	1.00
Weight	86 pounds 8 ounces	

Inside coil, 8 coils, right-hand spring:

Exterior diameter	inches..	5.56
Interior diameter	do...	3.06
Diameter of bar	do...	1.25
Height of spring unloaded	do...	13.41
Distance between coils	do...	.51
Weight	34 pounds 8 ounces	

	Height.	Load sustained.	Remarks.
	Inches.	*Pounds.*	
First spring	12.25	17,300	
	12.22	18,000	
	9.75	46,000	
	9.70	48,200	Closed down.
	9.75	45,200	
	11.90	18,000	
	12.25	13,700	
Second spring	12.25	16,500	
	12.12	18,000	
	9.75	44,400	
	9.59	47,200	Closed down.
	9.75	43,700	
	11.78	18,000	
	12.25	13,000	
Third spring	12.25	16,700	
	12.13	18,000	
	9.75	45,400	
	9.67	48,400	Closed down.
	9.75	44,700	
	11.75	18,000	
	12.25	12,900	
Fourth spring	12.25	17,500	
	12.20	18,000	
	9.75	45,800	
	9.72	46,700	Closed down.
	9.75	45,400	
	11.82	18,000	
	12.25	13,200	
Fifth spring	12.25	18,000	
	12.25	18,000	
	9.75	47,800	
	9.68	48,800	Closed down.
	9.75	47,200	
	11.93	18,000	
	12.25	13,500	
Loaded 100 times, compressing to 10".25 height and returning to 12".25 height each time, after which the results were as follows:			
	12.25	15,400	
	12.04	18,000	
	9.75	44,600	
	9.68	48,700	Closed down.
	9.75	43,900	
	11.90	18,000	
	12.25	14,500	
Spring now closed down and so remained for a period of 20 hours, after which the results were as follows:			
	12.25	16,500	
	12.15	18,000	
	9.75	46,700	
	9.67	48,400	Closed down.
	9.75	46,400	
	11.90	18,000	
	12.25	14,500	

Supplementary Tests of Helical Springs, Double Coil, for 10-Inch Mortar Carriages.

From lot of 12 springs received January 25, 1902.

	Height.	Load sustained.	Remarks.
	Inches.	*Pounds.*	
First spring	12.25	17,200	
Free height before test:	12.18	18,000	
Outside coil...inches.. 14.34	9.75	46,300	
Inside coil.....do... 13.35	9.68	49,700	Closed down.
	9.75	45,900	
	11.87	18,000	
	12.25	14,000	
	9.75	46,200	
	12.25	15,400	
	9.75	46,200	
Free height after test:	9.67	49,800	Closed down.
Outside coil...inches.. 14.30	9.75	45,800	
Inside coil.....do... 13.35	12.25	13,700	
First spring (test repeated)	12.25	16,700	
Free height before test:	12.12	18,000	
Outside coil...inches.. 14.30	9.75	46,100	
Inside coil.....do... 13.35	9.67	49,700	Closed down.
	9.75	45,600	
	11.84	18,000	
	12.25	13,700	
	9.75	46,000	
	12.25	14,100	
	9.75	46,100	
Free height after test:	9.67	49,700	Closed down.
Outside coil...inches.. 14.28	9.75	45,900	
Inside coil .....do... 13.35	12.25	13,600	
Third spring	12.25	17,100	
Free height before test:	12.18	18,000	
Outside coil...inches.. 14.13	9.75	46,200	
Inside coil .....do... 13.42	9.63	48,800	Closed down.
	9.75	44,500	
	11.78	18,000	
	12.25	12,900	
	9.75	45,400	
	12.25	13,000	
	9.75	44,900	
Free height after test:	9.63	49,800	Closed down.
Outside coil...inches.. 14.09	9.75	45,100	
Inside coil .....do... 13.35	12.25	12,500	
Third spring (test repeated)	12.25	15,900	
Free height before test:	12.06	18,000	
Outside coil...inches.. 14.09	9,75	44,900	
Inside coil .....do... 13.35	9.63	48,800	Closed down.
	9.75	43,800	
	11.77	18,000	
	12.25	12,800	
	9.75	44,400	
	12.25	12,400	
	9.75	44,300	
Free height after test:	9.64	48,500	Closed down.
Outside coil...inches.. 14.05	9.75	43,600	
Inside coil .....do... 13.32	12.25	12,400	

SUPPLEMENTARY TESTS OF HELICAL SPRINGS, ETC.—Continued.

SPRING COMPRESSED FROM HEIGHT OF 12".25 TO 10".25 100 TIMES.

Third spring:		
Free height before compressing 100 times—		
Outside coil	inches..	14.05
Inside coil	do...	13.82
First compression—		
Load at 12".25	pounds..	15,100
Load at 10".25	do...	38,500
One hundredth compression—		
Load at 12".25	do...	12,900
Load at 10".25	do...	38,200
Free height after compressing 100 times—		
Outside coil	inches..	14.05
Inside coil	do...	13.81

AFTER BEING COMPRESSED FROM 12".25 TO 10".25 100 TIMES.

	Height.	Load sustained.	Remarks.
	Inches.	*Pounds.*	
Third spring	12.25	15,100	
	12.03	18,000	
	9.75	44,400	
	9.63	48,700	Closed down.
Free height after test:	9.75	43,700	
Outside coil ..inches.. 14.04	11.76	18,000	
Inside coil .....do... 13.31	12.25	12,500	
Fifth spring	12.25	17,000	
Free height before test:	12.17	18,000	
Outside coil ..inches.. 14.05	9.67	48,500	Closed down.
Inside coil .....do... 13.48	11.90	18,000	
	12.25	14,000	
	9.67	48,400	Closed down.
	11.88	18,000	
	12.25	13,700	
Free height:			
Outside coil ..inches.. 14.03	12.25	16,500	
Inside coil .....do... 13.44	12.14	18,000	
	9.67	48,700	Closed down.
	11.89	15,000	
	12.25	14,200	
	9.67	48,700	Closed down.
	11.87	18,000	
	12.25	13,800	
Free height:			
Outside coil ..inches.. 14.01	12.25	16,400	
Inside coil .....do... 13.43	11.50	25,600	
	12.25	16,100	
	11.00	31,400	
	12.25	15,400	
	10.50	37,200	
Free height after test:	12.25	15,100	
Outside coil ..inches.. 14.01	10.00	43,000	
Inside coil .....do... 13.43	12.25	14,300	

Additional tests were made on spring No. 5. After resting without load a period of 4 days the spring was returned to the testing machine. When again loaded it sustained 17,000 pounds at a height of 12".25, against 18,000 pounds at the commencement of the original test and 14,500 pounds at the same height at the close of the first test.

	Pounds.
In the present instance, after closing down, the load sustained on the return movement was.	14,000 (*a*)
After closed down a second time	13,700 (*b*)
Load released to zero, then again loaded	16,500
Closed down and returned	14,200 (*a*)
Closed down again and returned	13,800 (*b*)

The conditions of the tests were similar in instances (*a*) (*a*), and likewise in (*b*) (*b*), and it is seen that the loads sustained are practically alike in each of the two of the same group.

The spring was again completely unloaded and compressed successively increased amounts.

It is now shown that the load sustained by the spring at 12″.25 height is as follows:

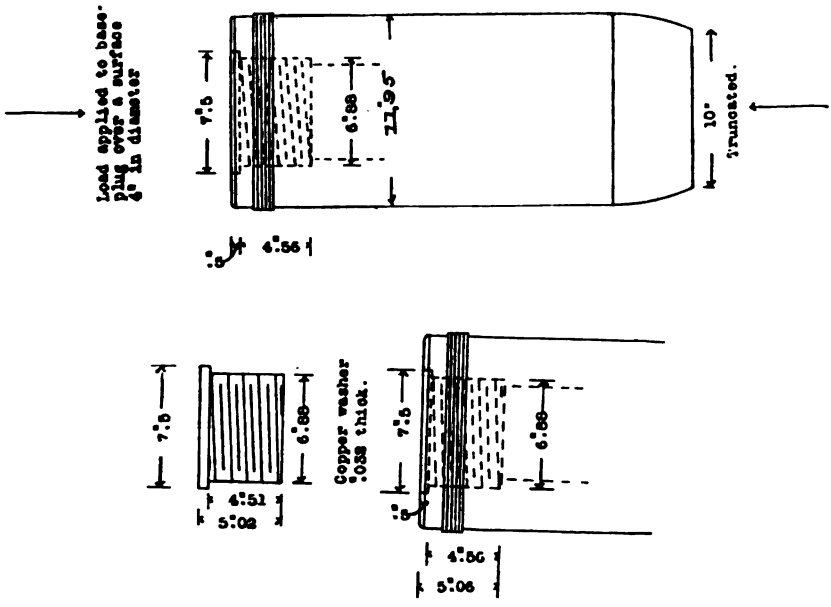
	Pounds.
First application of load	16,400
After compressing to 11″.50 height	16,100
After compressing to 11″.00 height	15,400
After compressing to 10″.50 height	15,100
After compressing to 10″.00 height	14,300

thus showing a gradual decrease in sustaining power, due to the manner of loading.

CAST IRON SHELL, 12-INCH MORTAR.

COMPRESSIVE MOVEMENT OF BASE PLUG AND DIAMETRICAL EXPANSION OF SHELL.

CAST-IRON SHELL, 12-INCH MORTAR.



COMPRESSIVE MOVEMENT OF BASE PLUG.

READINGS TAKEN ON BREECH PLUG 2½" FROM CIRCUMFERENCE OF SHELL.

Applied loads.	Longitudinal compression.	Remarks.
Pounds.	*Inches.*	
5,000	0.	Initial load.
10,000	0.	
20,000	.0003	Movement took place in an inward direction, longitudinally.
40,000	.0013	
60,000	.0023	
100,000	.0040	
150,000	.0049	
200,000	.0055	
250,000	.0060	
300,000	.0064	
400,000	.0070	
500,000	.0076	
600,000	.0084	
700,000	.0091	
800,000	.0096	
5,000	.0088	

COMPRESSIVE MOVEMENT OF BASE PLUG—Continued.

READINGS TAKEN ON BREECH PLUG 23″ FROM CIRCUMFERENCE OF SHELL—Continued.

Applied loads.	Longitudinal compression.	Remarks.
Pounds.	*Inches.*	
800,000	.0080	
5,000	.0084	
		Shell removed from the testing machine and examined. Breech plug indented, that part of surface acted upon by loading fixture 4″ diameter, ″.04. The end surface of the plug was found concaved ″.03 in addition to the ″.04 indentation. A spanner was applied and a slight gain obtained on the screw thread of the plug. Shell returned to the testing machine, and observations on the same gauged length repeated as before.
5,000	0.	Initial load.
800,000	.0070	
5,000	.0011	
800,000	.0070	
5,000	.0012	

READINGS TAKEN ON THE BASE OF THE SHELL 1¼″ FROM CIRCUMFERENCE.

5,000	0.	
800,000	.0012	
5,000	0.	
800,000	.0012	
5,000	0.	
800,000	.0012	
5,000	0.	

DIAMETRICAL EXPANSION OF SHELL.

READINGS TAKEN ON DIAMETER AT THE REAR OF THE BAND, MIDWAY BASE AND BAND.

Applied loads.	Diametrical expansion.	Remarks.
Pounds.	*Inches.*	
5,000	0.	Initial load.
800,000	—.0006	
5,000	0.	
800,000	—.0006	
5,000	0.	

ON DIAMETER ¼″ IN FRONT OF BAND.

5,000	0.	Initial load.
800,000	.0037	
5,000	0.	
800,000	.0036+	
5,000	0.	

ON DIAMETER 5¼″ IN FRONT OF BAND.

5,000	0.	Initial load.
800,000	.0019	
5,000	0.	
800,000	.0019	
5,000	0.	

ON DIAMETER 10¼″ IN FRONT OF BAND.

5,000	0.	Initial load.
800,000	.0013	
5,000	0.	
800,000	.0014	
5,000	0.	

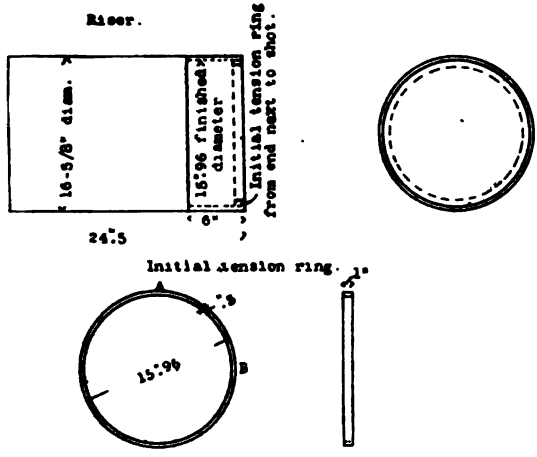
Initial Strains in 16-inch Cast-Iron Shot.

Initial tension ring and tensile tests from riser of a 16-inch cast-iron solid shot.

Dimensions of riser:

	Inches.
Diameter	16⅛
Length	24½

Exterior of riser, at the end next to the shot, turned down to 15".96 diameter for a length of 6 inches. An initial tension ring taken from the turned end of the riser, measured while the riser was intact, and again after the ring was detached.



Measured on diameters A and B:

Condition of ring.	Diameters.		
	A.	B.	Mean.
	Inches.	*Inches.*	*Inches.*
Riser intact	15.9601	15.9600	15.96005
Ring detached	15.9588	15.9606	15.9597

Strains released and computed stress:

Condition of ring,	Strains released, diameters.			Corresponding stress.
	A.	B.	Mean.	
	Inch.	*Inch.*	*Inch.*	*Lbs. per sq. in. tension.*
Detached	−.0013	+.0006	−.00035	400

Assumed modulus of elasticity, 18,000,000 pounds per square inch.

The detached ring was subsequently cut apart radially, whereupon the ends opened ".079, showing the relief of residual strains, tension at the exterior, compression at the interior, which did not find complete relief when the ring was detached from the body of the casting.

TENSILE TESTS.

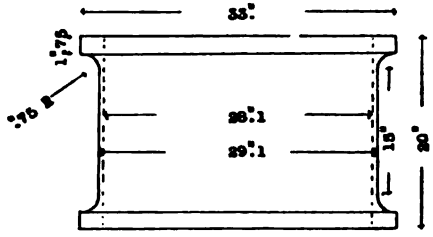
No. of test.	Direction of specimen.	Tensile strength per square inch.	Fracture.	Specific gravity.
		Pounds.		
6756	Longitudinal	22,190	Coarse granular, gray	
6757	Tangential	28,400	Fine and coarse granular, gray	7.164
6758	Radial	24,820	do	7.148

HYDROSTATIC TESTS OF TWO GUN HOOPS.

No. 17093 B3, A STREAKED HOOP.
No. 17959 B4, AN UNSTREAKED HOOP.

Material Tested and Methods Employed.

Two hoops, one originally intended for a 10-inch A3 hoop, the other a 10-inch A2 hoop, of streaked and unstreaked metal, respectively, were tested to destruction by means of interior hydrostatic pressures. The hoops were finished for testing to the shape and dimensions here shown:



The walls at the central part of each hoop, for a length of 15 inches, were one-half inch thick. Flanges were left on the ends to reenforce the strength of the hoop over the hydraulic packings.

The testing was done with a fixture consisting of a body, flanged at the lower end, over which the hoop was placed, and surmounted by a cap bolted to the body. An annular space, ".75 wide on a side, existed between the interior surface of the hoop and the exterior surface of the body, which space contained the hydraulic packings. The end thrust of the packings was resisted by the flange at the bottom of the body in one direction and by the cap in the other. Communication was established between the annular space and the testing machine through hydraulic piping, and the straining of the hoop was effected by admitting oil or water under gradually increasing pressures.

A caliper arm carrying micrometer points was mounted opposite the middle diameter of the hoop under test, and observations taken on the expansions and permanent sets acquired by the application of advancing pressures and their release. At pressures 2,000 and 3,000 pounds per square inch below the elastic limits of the streaked and unstreaked hoops, respectively, the loads were applied and released 500 times with each hoop. Thereafter the pressures were gradually increased, passing the elastic limits of the material and approaching the limit of rupture.

There were interruptions during the final stages of the tests, once with the streaked hoop, several times with the unstreaked one, when it was necessary to machine the flanges or modify the testing fixture to compensate for the distortion of the test piece. The distortion finally became so great with the unstreaked hoop as to require the use of staves and a retaining band acting against the flanges to restrict further longitudinal contraction of the hoop, which otherwise might have gone beyond the compensating limits of the fixture. This occurred when the indications of the test were that a close approach to the ultimate strength of the material had been reached, a stress considerably in excess of the strength of the tensile specimens having been applied. Circumferential extension was not opposed by the presence of the staves excepting indirectly by the restriction of longitudinal contraction of the hoop as a whole.

The minimum values shown in the specimen tests of the physical qualities found in the specimens were as follows:

	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction.
	Pounds.	*Pounds.*	*Per cent.*	*Per cent.*
Streaked hoop	54,000	102,400	15.0	38.3
Unstreaked hoop	56,000	110,000	12.0	35.2

CHEMICAL ANALYSIS OF STREAKED HOOP.

Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.
Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
.640	.792	.277	.022	.022

General Results of the Tests.

Each hoop endured a stress 2,000 and 3,000 pounds per square inch, respectively, below the elastic limit, repeated 500 times, without sensible permanent set in diameter. The elastic limit of each hoop under hydrostatic test coincided with the minimum value found in the specimen tests of the metal.

In ultimate bursting strength the streaked hoop showed a deficiency over the specimen tests; the unstreaked hoop showed an excess in strength over the specimen tests. The numerical values obtained were as follows:

HYDROSTATIC TESTS.

	Hoop.	
	Streaked per square inch.	Unstreaked per square inch.
	Pounds.	*Pounds.*
Elastic limit	54,000	56,000
Ultimate strength	91,051	125,889
Elongation (circumferential) per cent.	3.92	18.5

In circumferential elongation the relation of the hydrostatic to the specimen tests was similar to the results on ultimate strength. There was a deficiency of elongation displayed by the streaked hoop; an excess of elongation displayed by the unstreaked hoop with reference to the specimen tests of the metal.

From the original thickness, ".50, the walls of the streaked hoop drew down to ".483 at the fractured edge, and the unstreaked hoop drew down to ".436, the contraction in the thickness of the two hoops was therefore:

	Contraction at fractured edge.
	Inch.
Streaked hoop	.017
Unstreaked hoop	.064

The character of the fractured surface in each hoop was granular, radiating from the incipient point.

The line of fracture in the streaked hoop had its origin at the principal streak of the exterior surface, an interrupted line of alternate seamy and sound metal 4⅛ inches long by 0.15 inch deep in an oblique direction at its maximum. This and other streaks in the hoop gradually increased in prominence as the interior pressures advanced beyond the elastic limit of the metal.

The unstreaked hoop fractured along an element not previously characterized by any unusual local appearance of the metal.

Comparisons of the Results and Conclusions Reached.

(1) The elastic limits of the hoops possessed the values indicated by the specimen tests.

(2) Each hoop successfully endured 500 repetitions of a load closely approaching, but within the elastic limit of the metal.

(3) The presence of streaks exerted a marked influence on the ultimate strength and elongation of the metal.

(4) The actual bursting strength of the unstreaked hoop was 34,838 pounds per square inch above that of the streaked one, or corrected for the difference in the specimen tests of the metal the above became 27,238 pounds per square inch. Under the corrected figures the strength of the streaked hoop is 77 per cent that of the unstreaked.

(5) Compared with their respective tensile specimens the following values appear: Streaked hoop, deficiency in strength, 11,349 pounds per square inch; unstreaked hoop, excess in strength, 15,889 pounds per square inch; the streaked hoop has 88.9 per cent the strength of the specimen test; the unstreaked hoop has 114.1 per cent the strength of the specimen test.

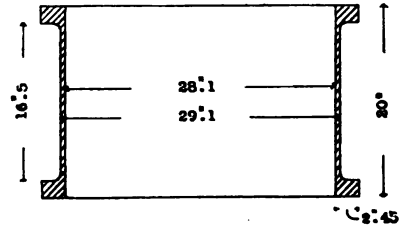
(6) The elongation of the streaked hoop was 26.1 per cent that of the specimen test; the elongation of the unstreaked hoop was 154.1 per cent that of the specimen test.

(7) The excess in strength and elongation of the unstreaked hoop over the specimen test is attributed to the reinforcing influence of the flanges of the hoop.

(8) The deficiency in strength and elongation of the streaked hoop over the specimen test is attributed to the presence of streaks in the metal.

Details o Tests.

HYDROSTATIC TEST OF STREAKED HOOP 17093 B3. ORIGINALLY A 10″ A3 HOOP.



Expansion of the hoop measured at the middle of its length on one diameter.

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
173	5,000	0.	Initial load.
346	10,000	.0051	
518	15,000	.0098	
691	20,000	.0150	
864	25,000	.0195	
1,037	30,000	.0234	
1,209	35,000	.0283	
1,382	40,000	.0333	
173	5,000	0.	
Hoop rested 12 days.		Pressures maintained ranging from 200 to 600 pounds per square inch.	
173	5,000	0.	
1,382	40,000	.0342	
173	5,000	.0002	
1,382	40,000	.0337	
1,555	45,000	.0391	
1,728	50,000	.0455	
173	5,000	.0003	
173	5,000	.0040	Micrometer reading after resting 1 hour.
1,797	52,000	.....	
173	5,000	.0040	
1,797	52,000	.....	Applied 25 times.
173	5,000	.0040	
1,797	52,000	.....	Applied 25 times.
173	5,000	.0038	
1,797	52,000	.....	Applied 50 times.
173	5,000	.0020	
1,797	52,000	.....	Applied 100 times.
173	5,000	.0040	
1,797	52,000	.....	Applied 33 times.
173	5,000	.0040	
173	5,000	.0025	Micrometer reading after resting over night.
1,797	52,000	.....	Applied 67 times.
173	5,000	.0026	
1,797	52,000	.....	Applied 200 times.
173	5,000	.0040	
173	5,000	.0051	Micrometer reading after resting 1 hour.
1,866	54,000	.....	Elastic limit.
173	5,000	.0061	
1,935	56,000	.....	
173	5,000	.0569	
2,004	58,000	.....	
173	5,000	.1784	
2,073	60,000	.....	
173	5,000	.2220	Enlargement of hoop most marked along zones 6″ and 12″ from one end. N. & S. diam. ″.016 larger than E. & W. diameter.
2,142	62,000	.....	
173	5,000	.2650	Seams opened perceptibly in 3 places.
2,211	64,000	.....	
173	5,000	.3066	
2,280	66,000	.....	
173	5,000	.3528	
173	5,000	.3495	Micrometer reading after resting over night. Photographed principal seam.

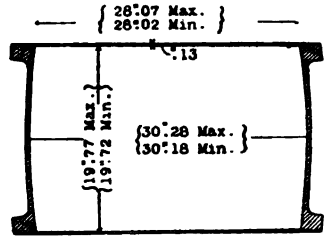
DETAILS OF TESTS—Continued.

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
2,349	68,000	.....	
173	5,000	.3907	
2,419	70,000	.....	
173	5,000	.4373	
2,488	72,000	.....	
173	5,000	.4910	
2,557	74,000	.....	
173	5,000	.5461	
2,626	76,000	.....	
173	5,000	.5811	
2,695	78,000	.....	
173	5,000	.6500	
2,764	80,000	.....	
173	5,000	.7222	
3,244	93,883	.....	Pressure momentarily reached.

Exterior diameter at middle of length, 30″.27. Maximum and minimum **diameters,** ″.077 difference.

Packing at lower end blew out a distance of 12″ on the circumference.

Hoop removed from the testing attachment and measured as follows:



Diameters at middle of length, 30″.28, maximum; 30″.18, minimum.

Original exterior diameter, called, 29.101; hence elongation of metal is 3.88 per cent.

Streaks plainly visible on the exterior cylindrical surface measured:

Principal streak along which rupture subsequently occurred.

<″.65> <″.93> <″.75> <″.80>
<″.35> <″.30> <″.55>

Detached streaks, scattered over surface.

<″.35> <″.27> <″.40> <″.35> <″.60>

Streak second in extent.

<″.15> <″.35> <″.33> <″.40>
<″.25> <″.25> <″.55>

The streaks which were scattered over the interior surface measured:

<″.50> <″.38> <″.25> <″.25> <″.35> <″.12> <″.27>
<″.15> <″.15> <″.25>

Streaks on the inside were not abreast those visible on the outside of the hoop. The several streaks acquired greater prominence after pressures were applied which strained the metal beyond the elastic limit. Prior to the application of such pressures the general surface of the hoop was smooth, and apparently so remained up to the time of reaching the elastic limit. Under higher interior pressures a roughness appeared at the streaks, the metal on one side rising slightly above the general surface, opening fissures which dipped obliquely, some in one direction and some in the opposite way. After the fracture of the hoop it was found that the metal at the principal streak was affected for a distance of about ".15, penetrating to a depth of ".04±.

In the principal streak and also in three other cases there were sections of continuous metal between ends of open cracks. All of the streaks here referred to were of the type in which continuity of the metal is wanting; that is, they were seams existing in the steel. In addition to those measured, there were others of a less pronounced order which were not sensibly affected by stresses above the elastic limit of the steel. There were faint nebulous patches occasionally found—clusters of minute, irregular-shaped cavities.

TEST OF HOOP RESUMED.

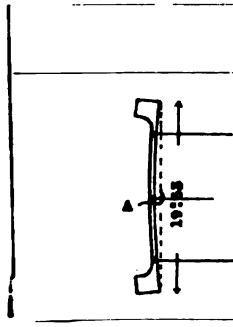
The flanges were chamfered, now measuring 1".42 in length at outer edge. Connections made with high-pressure auxiliary cylinder. Diameter of piston, 3".37; sectional area, 8".92.

Hoop ruptured under load of 28,100 pounds on piston of auxiliary cylinder, which gives 3,150 pounds per square inch interior pressure. Referred to the original dimensions of the hoop, the fiber stress corresponding to the interior pressure is 91,051 pounds per square inch. This stress is regarded as the more reliable value of the strength of the metal than the load previously mentioned as momentarily reached. A longitudinal line of rupture developed, passing through the principal streak of the exterior surface of the hoop, being the same line of streaked metal most prominent throughout the test, and shown by the photograph taken after the application of 66,000 pounds per square inch fiber stress.

The line of fracture of the hoop began about midway the length of the streaked section, or 5".6 from one end of the hoop, as shown by the center of radiation of the fractured surface, which was granular throughout. After removing the hoop from the testing attachment the width of opening of the fractured ends ranged from 1".02 to 1".08 at the streaked section, ".96 at the nearer end under the flange and ".88 at the farther end under the flange. Along the streaked section a distance of 4⅛" the fractured surface took an irregular course; the balance of the fracture on either side followed more direct courses to the ends of the hoop. In the streaked section there was a flaky, lamellar appearance, the metal separating along oblique planes with reference to the exterior cylindrical surface. The overlapping metal reached a maximum width of ".15 and depth of about ".04. The thickness of the walls adjacent to the fractured surface was ".482 at the middle of the length of the hoop; at the place where rupture began the thickness was ".490, while at the corresponding distance from the opposite end the thickness was ".486. The circumference at the middle of the length and exterior of the hoop measured, after fracture,

95", an extension over the original circumference of 3".58=3.92 per cent. At the middle of the length of the principal streak the circumference measured 1 inch less, or 94" circumference, an extension over the original of 2".58=2.82 per cent.

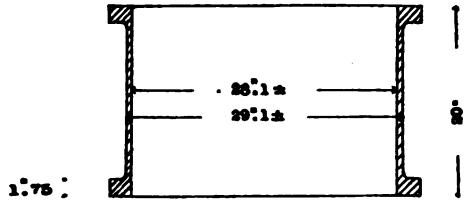
Near the fillets at the flanges the circumferences were 92".31 and 92".37. Thickness of walls:



	At fractured edge.	4 inch from edge.
	Inch. .490	*Inch.* .493
	.482	.487
	.496	.499

The versed sines A of chord at the different quarters were ".80, ".61, ".61, ".62, the first mentioned being taken next the line of fracture.

HYDROSTATIC TEST OF UNSTREAKED HOOP 17959 B4. ORIGINALLY A 10" A2 HOOP.



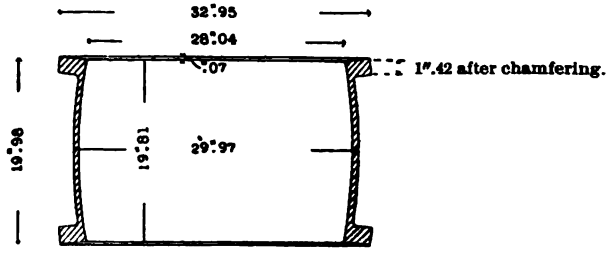
Expansion of the hoop measured at the middle of its length on one diameter.

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
173	5,000	0.	Initial load.
346	10,000	.0050	
518	15,000	.0099	
691	20,000	.0148	
864	25,000	.0197	
1,037	30,000	.0248	
1,209	35,000	.0294	
1,382	40,000	.0343	
173	5,000	.0016	
1,555	45,000	.0393	
1,728	50,000	.0443	
1,881	53,000	.0471	
173	5,000	.0022	

Interior pressure per square inch.	Fiber stress per square inch.	Expansion in diameter.	Remarks.
Pounds.	*Pounds.*	*Inch.*	
1,831	53,000	.....	Applied 25 times.
173	5,000	.0024	
1,831	53,000	.....	Applied 25 times.
173	5,000	.0024	
1,831	53,000	.....	Applied 50 times. Noon intervened after 37th loading.
173	5,000	.0013	
1,831	53,000	.....	Applied 100 times.
173	5,000	.0031	
1,831	53,000	.....	Applied 100 times.
173	5,000	.0019	
1,831	53,000	.....	Applied 100 times.
173	5,000	.0024	
173	5,000	.0008	Rested 16 hours.
1,831	53,000	.....	Applied 100 times.
173	5,000	.0015	
1,866	54,000	.0480	
173	5,000	.0019	
1,935	56,000	.....	Elastic limit.
173	5,000	.0019	
2,004	58,000	.....	
173	5,000	.0218	
2,073	60,000	.....	
173	5,000	.0897	
2,142	62,000	.....	
173	5,000	.1232	
2,211	64,000	.....	
173	5,000	.1556	
2,280	66,000	.....	
173	5,000	.1888	
2,349	68,000	.....	
173	5,000	.2232	
2,419	70,000	.....	
173	5,000	.2600	
2,488	72,000	.....	
173	5,000	.3002	
2,557	74,000	.....	
173	5,000	.3405	
2,626	76,000	.....	
173	5,000	.3815	
2,695	78,000	.....	
173	5,000	.4287	
2,764	80,000	.....	
173	5,000	.4833	
3,239	93,760	.....	Maximum pressure applied.
173	5,000	.8745	

Test of hoop by means of the direct accumulator pressure discontinued.

Hoop removed from testing attachment and measured as follows:



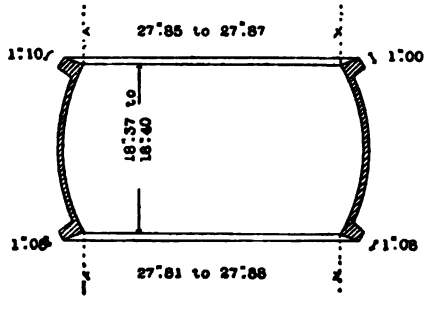
Expansion in diameter, ".8745=3 per cent.

Flanges chamfered at the outer edge to a length of 1".42.

Hoop returned to the testing attachment and connections made with high pressure auxiliary cylinder.

Interior pressure per square inch.	Fiber stress per square inch.	Remarks.
Pounds.	*Pounds.*	
3,321	96,127	Auxiliary cylinder recharged between times of applying the pressures. Load reduced about one-half at the time.
3,419	98,696	
3,500	101,294	
3,556	102,911	
3,656	105,826	
3,730	107,963	
3,734	108,078	Lower packing of hoop blew out. Under diminished loads, about one-half the original, the circumference of the hoop at the middle of its length measured: After 3,419 pounds per square inch, circumference 96″.00; after 3,666 pounds per square inch, circumference 96″.37; after 3,744 pounds per square inch, with the pressure entirely removed, circumference 96″.69=5.76 per cent extension. At the ends of the hoop, under the flanges, the interior diameter was 27″.98 to 28″.00.
Hoop removed from attachment, ends faced and chamfered an additional ½″. Test resumed.		
3,846	111,311	
3,903	112,957	Circumference 98″.15 under 1,200 pounds per square inch interior pressure.
3,947	114,227	Circumference 98″.87 under 1,200 pounds per square inch interior pressure.
3,969	114,891	Circumference 99″.65 under 1,200 pounds per square inch interior pressure.
4,014	116,190	Circumference 100″.4 under 1,200 pounds per square inch interior pressure.
4,047	117,142	Circumference 101″.25 under 1,200 pounds per square inch interior pressure.
4,056	117,460	Circumference 101″.68 under 1,200 pounds per square inch interior pressure = 11.2 per cent extension.
Lower packing blew out. Hoop removed from the attachment, ends again faced and chamfered ½″ additional. Length of flanges after chamfering are now 1″.30. During the last stage of testing the clearance (1″) provided in the recess of the cap of the testing attachment was exhausted, necessitating further chamfering. The hoop showed marked local bulging on one side. Ends were again faced and flanges rechamfered.		
4,070	117,806	Circumference, 102″.00 under 1,000 pounds per square inch interior pressure.
4,108	118,759	Circumference, 102″.50 under 1,000 pounds per square inch interior pressure.
4,137	119,740	Circumference, 103″.12 under 1,000 pounds per square inch interior pressure.
2,236	64,720	Rested under this load 1 hour and 20 minutes.
4,159	120,375	Circumference, 103″.62 under 1,000 pounds per square inch interior pressure.
4,159	120,375	Circumference, 104″.06 under 1,000 pounds per square inch interior pressure.
4,171	120,722	Circumference, 104″.45 under 1,000 pounds per square inch interior pressure=14.2 per cent expansion.

Packing blew out at lower end of hoop.
Hoop removed from testing fixture and measured as follows:



The middle part of the hoop was bulged on one side beyond the outer line of the flanges.

Hoop and fixture dismantled. The hoop was bored out at the ends, restoring the diameter to 28".1 for a length of $\frac{3}{8}$" to $\frac{9}{16}$" at each end. The body and cap of the testing fixture were each turned to 28".1 diameter to fit the interior diameter of the hoop, which they entered $\frac{1}{2}$" at each end. The cap was further recessed to a total depth of $3\frac{1}{2}$", and both the cap and flange at the base of the hoop were chamfered.

After an interval of nine days the modified parts were reassembled and the testing was resumed. The hydraulic packings were brought to a condition of action and the hoop kept under an interior pressure ranging from 2,800 to 2,600 pounds per square inch over night. This interval was followed by the application of higher pressures, as follows:

Interior pressure per square inch.	Fiber stress per square inch.	Remarks.
Pounds.	*Pounds.*	
4,187	121,184	
3,131	90,614	Rested 1 hour.
4,227	122,388	
2,236	64,720	Circumference, 105".40.
4,288	122,656	
2,236	64,720	
4,255	123,147	Auxiliary cylinder was recharged at frequent intervals.
4,272	123,637	
2,236	64,720	Circumference, 106".8=16.8 per cent expansion.

The hoop shortened rapidly in length, accompanying the circumferential expansion, rendering it desirable to employ exterior staves acting against the flanges to prevent the ends of the hoop drawing off the entering shoulders of the testing fixture. The staves were secured in position by means of a heavy encircling band and the use of steel wedges. The staves made contact with the hoop against the flanges and fillets only, clear space being preserved for further expansion at the middle part. Owing to leakage about the packings, which manifested itself subsequently to the last period of loading, induced during screwing down the cap of the testing fixture to shorten the attachment, it was now necessary to apply the higher interior pressures by pumping directly into the fixture. Connections were made with the auxiliary cylinder, the reaction against the piston was weighed upon the scale of the testing machine while the pressures were advanced by the accumulator pump. For the time being, the accumulator pump was worked under higher steam pressure than usual, beyond the capacity of the accumulator itself and its pressure gauge, both of which were temporarily disconnected, the cross-over connections with the auxiliary cylinder serving as the means of arriving at the interior pressure of the hoop.

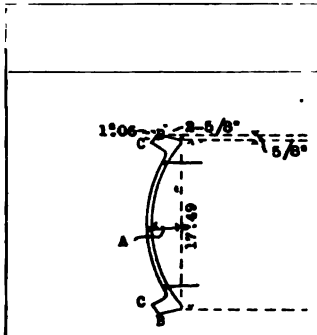
The interior pressure was now increased until the rupture of the hoop was effected, which occurred under a load of 38,900 pounds on the piston of the auxiliary cylinder, which gives 4,361 pounds per square inch interior pressure.

Referred to the original dimensions of the hoop, the fiber stress corresponding to this interior pressure is 125,889 pounds per square inch.

After rupture the circumference at middle of length and exterior of hoop measured 108".33=18.5 per cent expansion.

At the ends of the fillets, under the flanges, the circumferences measured 96″.42 and 96″.37.

Fracture began at the exterior surface of the hoop ″.9 from the middle of its length, and extended longitudinally through each flange. The fractured surface was granular, radiating from the point of commencement. Along the fractured edge and $\frac{1}{8}$″ distance therefrom the metal was drawn down to the following thicknesses:



	At fractured edge.	⅛ inch from edge.
	Inch.	*Inch.*
	.473	.480
	.436	.447
	.471	.477

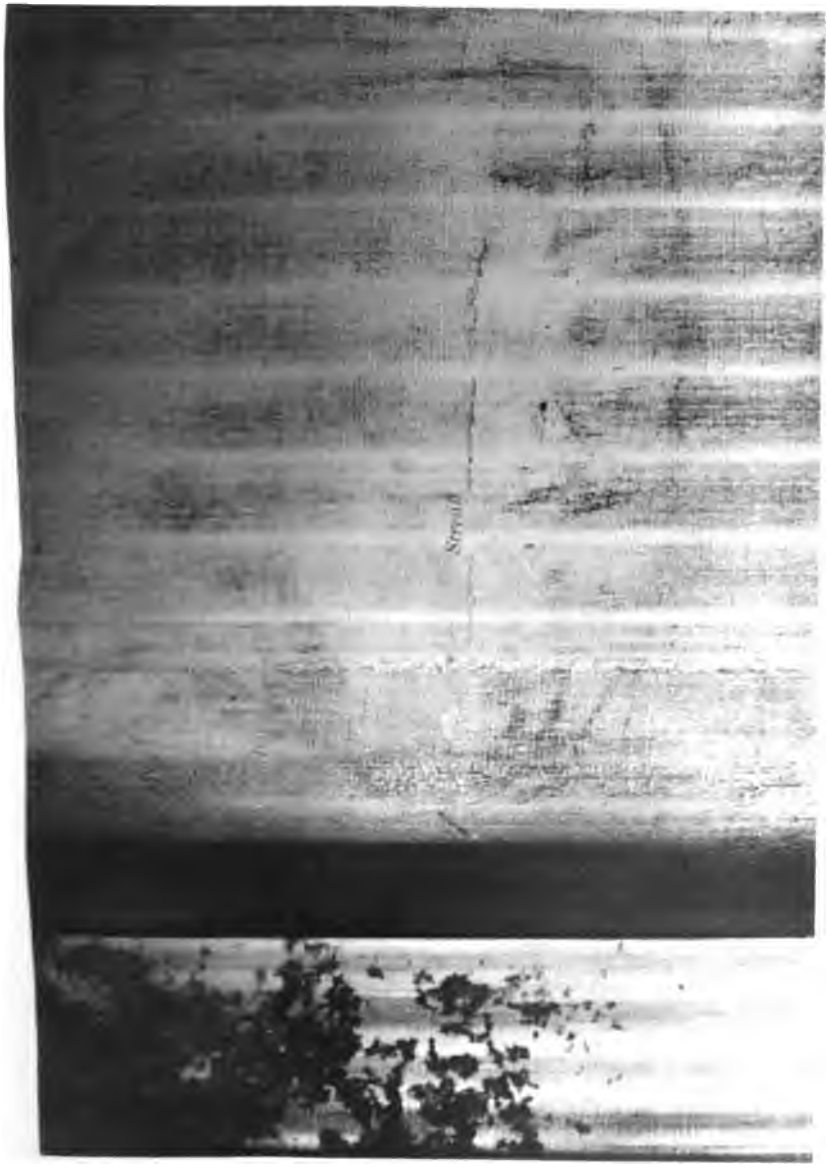
The versed sines A of chord at the different quarters were 2″.84, 2″.71, 3″.10 and 2″.96, the first mentioned being taken next the line of fracture. The present length at the interior surface was 17″.49, being reduced from the original length of 20″ in part by the bulging of the walls and in part by the successive facings in the lathe during chamferings.

The rent showed a maximum opening at the place where rupture began, and here the fractured ends were 8″.12 apart, at the lower fillet 7″.40, and at the upper fillet 7″.17.

An oblique fracture began in the upper half, extending in an irregular course 4½″. The latter appeared to be a secondary line of fracture, developed in respect to relative time after the separation of the metal in the lower half of the hoop.

The metal along the corners B, shown in the above sketch, was compressed during the progress of the test. At corners C the metal was extended, a result which followed the general distortion of the flanges.

During the last stage of the test a number of cracks having a longitudinal direction were developed on both the exterior and interior surfaces. The lengths of these cracks ranged from ″.05 to ″.18.

PHOTOGRAPHS SHOWING APPEARANCE OF STREAKED AND UNSTREAKED HOOPS DURING AND AFTER HYDROSTATIC TESTS.

NO. 1.

STREAKED HOOP 17093 B3.

APPEARANCE OF PRINCIPAL STREAK AFTER HOOP HAD BEEN LOADED WITH 66,000 LBS PER SQ. IN. TENSION. RUPTURE SUBSEQUENTLY OCCURRED AT THIS STREAK.

NO. 2.

STREAKED HOOP 17093 B3. APPEARANCE AFTER FRACTURE.

RUPTURE BEGAN AT STREAK AND EXTENDED LONGITUDINALLY IN EACH DIRECTION THROUGH THE FLANGES.

HELIOTYPE CO., BOSTON

NO. 3.

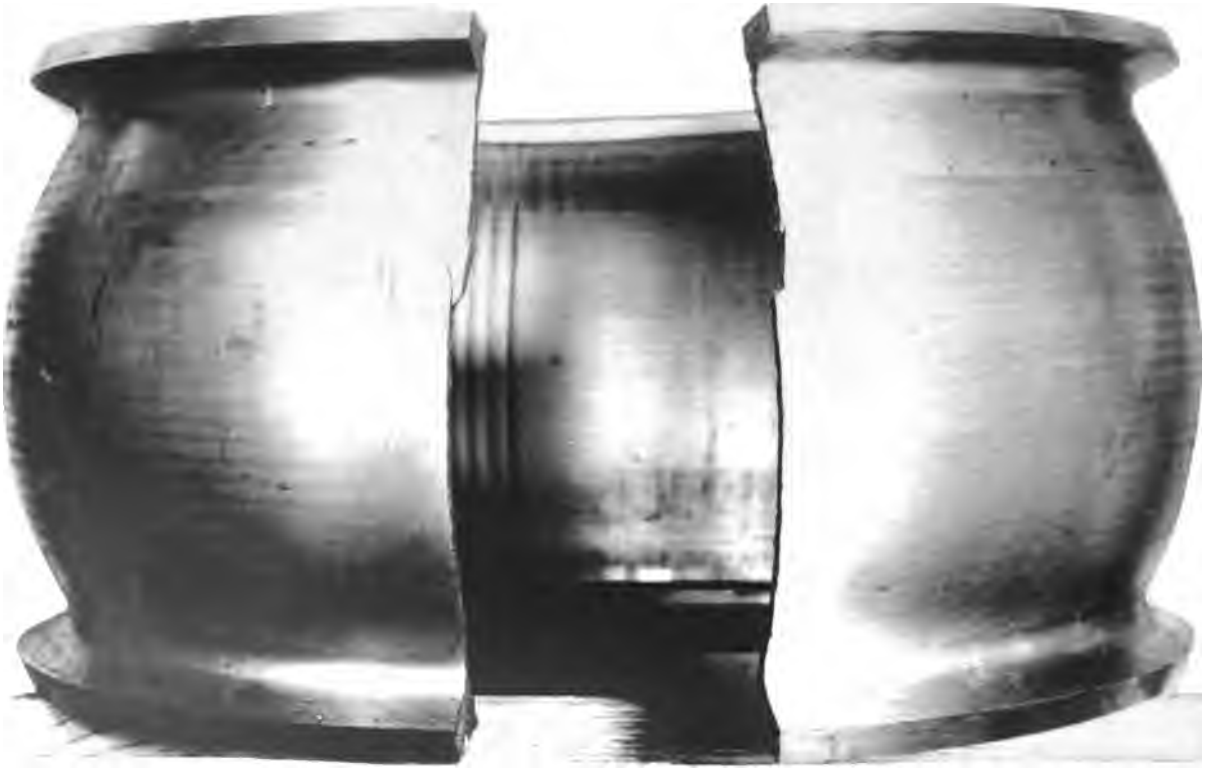
STREAKED HOOP 17093 B3.

FRONT VIEW OF THE LINE OF FRACTURE AT THE PRINCIPAL STREAK.

NO. 4.

STREAKED HOOP 1,093 B3.

VIEW OF PART OF THE FRACTURED SURFACE, AT THE PRINCIPAL STREAK.



NO. 5.

UNSTREAKED HOOP 17959 B4, AFTER FRACTURE. RUPTURE BEGAN 9 INCHES FROM THE MIDDLE OF LENGTH OF HOOP, EXTENDING THROUGH THE FLANGES. A SECONDARY FRACTURE STARTED IN THE UPPER HALF, TAKING AN OBLIQUE COURSE.

NO. 6.

UNSTREAKED HOOP 17969 B4.

GENERAL VIEW OF THE FRACTURED SURFACE.

HELIOTYPE CO., BOSTON.

NO. 7.

UNSTREAKED HOOP 17999 B1.

VIEW OF PART OF THE FRACTURED SURFACE

HELIOTYPE CO., BOSTON.

NO. 8.

STREAKED AND UNSTREAKED HOOPS AFTER FRACTURE, SHOWING THE COMPARATIVE ULTIMATE DISTORTION OF THE TWO.

THE UPPER HOOP, 17013-83, STREAKED. THE LOWER HOOP, 17[illegible]-84, UNSTREAKED.

HELIOTYPE CO., BOSTON

NO. 9.

STREAKED HOOP 1 7093 83, AFTER FRACTURE.

FROM NEAT STREAKS ON THE OUTSIDE AND INSIDE SURFACES RESPECTIVELY.

MAGNIFICATION 5 DIAMETERS.

HELIOTYPE CO., BOSTON

NO. 10.

STREAKED HOOP 17094 BR, PETER PRACTURE.

X 1, MCM STREAKED DEVELOPMENT EXTERIOR, AND NEGATIVE DEVELOPMENT INTERIOR SURFACES, RESPECTIVELY.

MAGNIFICATION 1 DIAMETERS.

HELIOTYPE CO., BOSTON

NO. 1*.

UNSTREAKED HOOP 1795) B4, AFTER FRACTURE.

CRATER LIKE CAVITY, INTERIOR SURFACE, AND INCIPIENT LINE OF FRACTURE,

EXTERIOR SURFACE, RESPECTIVELY.

MAGNIFICATION 5 DIAMETERS.

HELIOTYPE CO. BOSTON

ROCKER BLOCK AND TRACK BLOCKS.

COMPRESSION TESTS OF ROCKER BLOCK AND TRACK BLOCKS.

FIRST SERIES.

The material tested consisted of a rocker block of cast steel and track blocks of cast iron, cast steel, and forged steel, all of No. 2 grade of metal. The Midvale Steel Company furnished the castings for the rocker block and one of the track blocks. A duplicate cast steel track block was procured from the United States Steel Company, West Everett, Mass. The cast iron and forged steel blocks were from the arsenal shops. Their dimensions were 12″ square by 6″ thick. The rocker block was tested successively with the cast iron track block, the cast steel (Midvale) block, the forged steel, and finally the cast steel (Everett) block. The working faces of the blocks were carefully finished after machining, by hand scraping, to surfaces closely approaching true planes on the track blocks and to a cylindrical surface of 114″ radius on the rocker block.

In the first series of tests loads were applied not exceeding 400,000 pounds. In the second series the full capacity of the testing machine, 800,000 pounds, was employed. The details of the tests are reported in the order taken. A gauged length of 5″ was established on the ends of the pair of blocks being tested, symmetrical with the junction of the pieces and across the middle of their width. The direct compressions of the test pieces were determined by a micrometer covering this gauged length. Upon the completion of the two principal series of observations, sheets of thin tissue paper, one at a time, were placed between the working faces and loads applied for the purpose of securing an impression on the paper representing approximately the width of the surface in contact at different pressures. This was followed by micrometer observations on the lateral movement of the metal of the blocks, taken normal to the line of pressures applied, and normal also to the elemental line of contact on the working faces, and finally by means of a caliper arm the longitudinal extension of the metal of the rocker block was determined in two places, near the line of contact and at a place nearer the middle of the block. The strains developed during the tests were apparently within the elastic limits of the metals, excepting in the Everett cast steel track block, which showed the presence of sets, slowly increasing with loads of 600,000 pounds and upward.

There were negative sets, generally of small magnitude, which persistently appeared and have not yet been satisfactorily accounted for. Their presence led to extended observations, which, while not explaining the minus readings, showed otherwise uniformity of behavior throughout the tests. The effects of loads below 100,000 pounds pressure were observed to show the general behavior and judge of the adjustment of the blocks in the testing machine.

The results with the cast iron track block showed a total compression of ″.0030 under 400,000 pounds, or ″.0025 between the loads 100,000 and 400,000 pounds. In like manner the test with the cast steel (Midvale) block showed a total compression of ″.0025, or ″.0020 compression above 100,000 pounds load. The forged steel and the Everett cast steel blocks furnished almost identical results with the first cast steel piece. With the Everett cast steel block a series of micrometer read-

ings were taken under both ascending and descending loads, which showed the two paths coincided.

Higher pressures, increased to a maximum of 800,000 pounds, were next applied, returning to the use of the cast iron track block, and using the succeeding blocks in the same order as before. Minus sets still appeared, found upon release to the initial load. Repeated observations showed a satisfactory behavior in the rate and uniformity of compression between the limits of 100,000 and 800,000 pounds. Disregarding the minus readings, three of the blocks endured the full load of the testing machine—800,000 pounds—without appreciable injury. The Everett cast steel block displayed a plus set after receiving a load of 600,000 pounds, which was gradually increased under higher stresses, and reached ".0007 after 800,000 pounds was applied. The rocker block already having been loaded several times with 800,000 pounds, this permanent set must have been confined to the track block alone.

The direct compression of the individual blocks was next determined. The gauged length of 5″ was taken wholly on the rocker block, with one extremity ¼″ from the working face, the other 5¼″ away, and making similar observations on the track block. The blocks compressed ".0030 and ".0031, respectively, between the loads 100,000 and 800,000 pounds, aggregating a movement of ".0061, which, being greater than observed on the gauged length taken 2½″ on each block, shows an appreciable movement beyond the limits of the original gauged length taken from block to block.

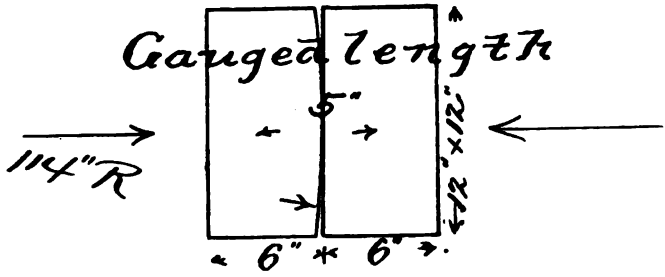
The next observations were made on the lateral movement of the metal in the blocks. Gauged lengths of 5″ each, across the ends of the blocks, normal to the direction of the applied loads, were established at different distances, ¼″ to 5″ from the working faces. A few measurements were made on gauged lengths of 3″ and 9″. The more complete results on the 5″ gauged lengths showed in the rocker block, at the distance of ¼″ from the working face, a lateral movement inward, or of compression, of ".0007. At ⅛″ from the face no lateral movement was found. At the more remote distances of 1½″ to 5″ the lateral movement was in the opposite direction; that is, outward or in a tensile direction, the maximum reading being ".0010. The cast steel (Everett) track block behaved in the same manner and developed strains of nearly the same magnitude.

These results on lateral movements show that the blocks, notwithstanding the rigidity of their proportions and the parts of the testing machine against which they abutted, acted as beams and were sensibly bent by the pressures employed. The metal on the side directly loaded was in compression, the opposite side in tension. The neutral axis was not found at the center of the cross section, but nearer the working face. This eccentric position is attributed to the combined effects of the direct compression, tending toward lateral expansion, and the bending of the blocks as beams, tending toward compression on the side having the working face.

Final observations were made on the longitudinal endwise extension of the rocker block, measured by means of a caliper arm over the end surfaces, in a direction parallel to the line of contact with the track block. At a distance of ¼″ from the working face the longitudinal extension was found to be ".0017 under 800,000 pounds, while at a distance of 2½″ from the face the longitudinal extension was about one-half the above amount.

A method for the exact determination of "the amount of elastic and permanent contact" has not been found. There is varying intensity of the stresses, due to the shape and dimensions of the blocks, and the careful observations made indicate the direction and extent of the principal strains developed and help to show the difficulties in any attempt to determine with precision further characteristics of the surfaces. The common method of judging, in an approximate manner, of the extent of the contact surfaces was employed on this occasion. A thin tissue paper was placed between the working faces, different pressures applied, and the impressions on the paper examined. Paper about ".0012 thick was used. It required 10,000 pounds compression to make a permanent impression. The impression, at first vague, becomes more distinct as the loads are increased. Under 800,000 pounds the width of the impression was about 1".8 with the forged steel track block and about 2" with the cast iron block.

General Results.



Compression Measured on a Gauged Length of 5", One-half the Distance on each Block, and Across the Middle of Width.

FIRST SERIES.

[Loads between 100,000 pounds and 400,000 pounds.]

Applied loads.	Compression. Rocker block tested with track blocks of—			
	Cast iron.	Cast steel (Midvale).	Forged steel.	Cast steel (Everett).
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*
100,000	0.	0.	0.	0.
150,000	.0005	.0004	.0004	.0004
200,000	.0009	.0007	.0007	.0007
250,000	.0013	.0011	.0010	.0011
300,000	.0017	.0015	.0014	.0014
350,000	.0021	.0018	.0017	.0017
400,000	.0025	.0020	.0020	.0020

SECOND SERIES.

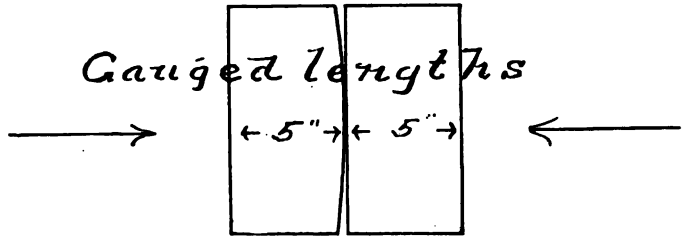
[Loads between 100,000 pounds and 800,000 pounds.]

Applied loads.	Compression. Rock block tested with track blocks of—				
	Cast iron.	Cast iron, block readjusted.	Cast steel (Midvale).	Forged steel.	Cast steel (Everett).
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
100,000	0.	0.	0.	0.	0.
200,000	.0008	.0008	.0007	.0006	.0008
300,000	.0017	.0017	.0014	.0013	.0014
400,000	.0024	.0024	.0020	.0019	.0019
450,000	.0027	.....	.0023	.0021	.0022
500,000	.0031	.0031	.0025	.0023	.0025
550,000	.0034	.....	.0028	.0026	.0028
600,000	.0037	.0036	.0030	.0029	[a] .0031
650,000	.0041	.....	.0033	.0031	[a] .0034
700,000	.0044	.0042	.0034	.0034	[a] .0037
750,000	.0047	.....	.0037	.0036	[a] .0040
800,000	.0051	.0047	.0039	.0037	[a] .0043

[a] These figures include set.

AMOUNT OF COMPRESSION OF INDIVIDUAL BLOCKS.

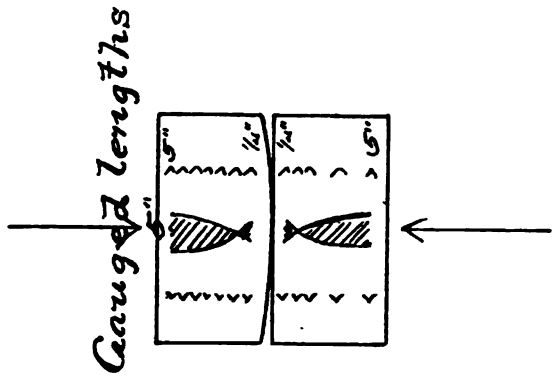
ROCKER BLOCK AND CAST STEEL (EVERETT) TRACK BLOCK.



Gauged lengths established as shown on the above sketch.

Applied loads.	Measurements taken on—		Remarks.
	Rocker block.	Track block.	
Pounds.	*Inch.*	*Inch.*	
100,000	0.	0.	Initial reading.
400,000	.0014	.0015	
800,000	.0030	.0031	

LATERAL MOVEMENT OF BLOCKS.



Applied loads.	Observations on rocker block on 5″ transverse gauged lengths taken at the following distances from the working face:						
	¼ inch.	½ inch.	1¼ inches.	2¼ inches.	3¼ inches.	4¼ inches.	5 inches.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
5,000	0.	0.	0.	0.	0.	0.	0.
800,000	.0007	0.	.0004	.0007	.0009	.0010	.0010

3″ GAUGED LENGTH.

800,000	.0005	.....	.....	.....	.....	.....	.....

9″ GAUGED LENGTH.

800,000	.0006	.....	.....	.....	.....	.....	.0016

DIRECTION OF ABOVE LATERAL MOVEMENTS.

.....	Inward.	Neutral.	Outward.

Applied loads.	Observations on cast steel (Everett) track block on 5″ transverse gauged lengths taken at the following distances from the working face:				
	¼ inch.	½ inch.	1¼ inches.	3¼ inches.	5 inches.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
5,000	0.	0.	0.	0.	0.
800,000	.0007	0.	.0004	.0010	.0012

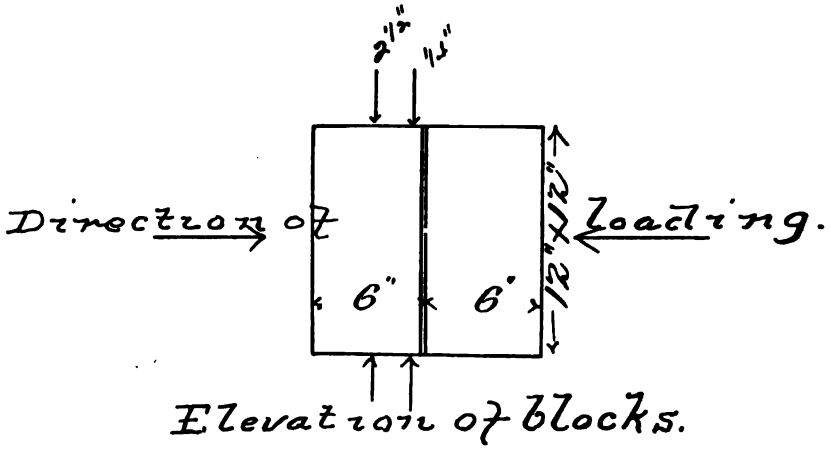
9″ GAUGED LENGTH.

800,000	.....	.....	.....	.....	.0014

DIRECTION OF ABOVE LATERAL MOVEMENTS.

....	Inward. Contraction in width.	Neutral.	Outward. Expansion in width of the block.

LONGITUDINAL EXTENSION, MEASURED OVER ENDS OF ROCKER BLOCK.



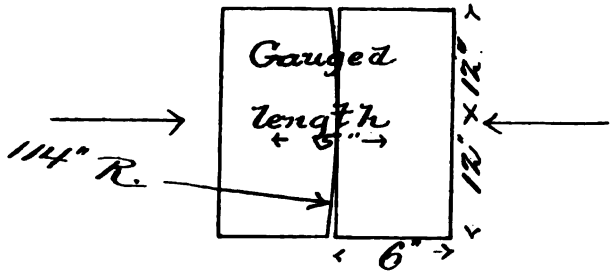
Applied loads.	Distance from working face.	
	¼ inch.	2½ inch.
Pounds.	*Inch.*	*Inch.*
5,000	0.	0.
400,000	.0007	.....
800,000	.0017	.0008

CHEMICAL ANALYSES OF ROCKER BLOCK AND TRACK BLOCKS.

Description.	Carbon.			Manganese.	Silicon.	Sulphur.	Phosphorus.
	Total.	Graphitic.	Combined.				
Cast steel rocker block and track block (Midvale)	.....	.....	.460	.752	.475	.045	.088
Cast steel track block (Everett)	.....	.....	.340	.680	.211	.178	.037
Forged steel track block (Watertown Arsenal)	.....	.....	.430	.762	.347	.070	.086
Cast iron track block (Watertown Arsenal)	3.100	1.918	1.182	.380	1.300	.048	.463

COMPRESSION TESTS OF A CAST STEEL ROCKER BLOCK, OF 114" RADIUS OF CURVATURE, WITH TRACK BLOCKS OF DIFFERENT METALS.

DETAILS.



The compressive strains and sets measured on a gauged length of 5". Details of the tests, first stage of loading, up to 400,000 pounds compression.

No. 10443.

CAST IRON TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
10,000	0.	.....	
20,000	0.	.....	
40,000	0.	−.0001	
50,000	.0001	.....	
60,000	.0002	−.0002	
70,000	.0003	.....	
80,000	.0004	−.0002	
90,000	.0005	.....	
100,000	.0005+	−.0002	
120,000	.0007	.....	
150,000	.0010	−.0002	
180,000	.0012	.....	
200,000	.0014	−.0002	
220,000	.0015	.....	
250,000	.0018	−.0003	
300,000	.0022	−.0003	
350,000	.0026	−.0008	
400,000	.0030	−.0008	
400,000	.0030	.....	Rested under load.
400,000	.0031	−.0002	
100,000	.0006	−.0002	

No. 10444.

CAST STEEL (MIDVALE) TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch*	*Inch.*	
5,000	0.	0.	Initial load.
10,000	0.	.....	
30,000	0.	.....	
40,000	.0001	−.0001	
60,000	.0002	.....	
80,000	.0003	.....	
100,000	.0005	−.0001	
120,000	.0007	.....	
150,000	.0009	−.0002	
180,000	.0011	.....	
200,000	.0012	−.0002	
220,000	.0014	.....	
250,000	.0016	−.0002	
300,000	.0020	−.0003	
350,000	.0023	−.0003	
400,000	.0025	−.0003	
400,000	.0025	.....	
400,000	.0025	−.0002	After resting 1 hour.
100,000	.0005	−.0002	

No. 10445.

FORGED STEEL TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
10,000	0.	.....	
30,000	0.	.....	
40,000	.0001	.....	
50,000	.0001	−.0002	
50,000	.0001	−.0002	
60,000	.0002	.....	
80,000	.0004	.....	
100,000	.0005	−.0002	
120,000	.0006	.....	
150,000	.0009	−.0003	
180,000	.0011	.....	
200,000	.0012	−.0003	
220,000	.0014	.....	
250,000	.0015	−.0003	
300,000	.0019	−.0003	
350,000	.0022	−.0003	
400,000	.0025	−.0003	
400,000	.0025	.....	
400,000	.0025	−.0003	After resting 1 hour.
100,000	.0005	−.0003	

No. 10446.

CAST STEEL (EVERETT) TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
10,000	0.	.....	
30,000	.0001	.....	
40,000	.0002	.....	
50,000	.0002	−.0001	
60,000	.0003	.....	
80,000	.0004	.....	
100,000	.0006	−.0002	
120,000	.0007	.....	
150,000	.0010	−.0002	
180,000	.0012	.....	
200,000	.0013	−.0002	
220,000	.0015	.....	
250,000	.0017	−.0002	
300,000	.0020	−.0002	
350,000	.0023	−.0002	
400,000	.0026	−.0003	
400,000	.0026	.....	
400,000	.0025+	−.0004	After resting 1 hour.
100,000	.0005	−.0004	
Rested overnight under about 1,000 pounds pressure.			
5,000	.....	−.0001	
100,000	.0005	−.0002	
400,000	.0025	−.0005	
400,000	.0025	−.0004	
400,000	.0025	−.0004	
50,000	.0001	−.0004	
50,000	.0001	.....	
100,000	.0005	.....	
200,000	.0013	.....	
300,000	.0020	.....	
400,000	.0026	.....	
300,000	.0020	.....	
200,000	.0013	.....	
100,000	.0005	.....	
50,000	.0001	−.0004	

TESTS OF BLOCKS UNDER HIGHER PRESSURE.

No. 10443a.

CAST IRON TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
10,000	0.	.....	
50,000	.0003	.....	
100,000	.0007	0.	
150,000	.0011	.....	
200,000	.0015	−.0007	
200,000	.0015	−.0007	Repeated.
50,000	0.	−.0008	
Micrometer removed, cleaned, and returned to position.			
5,000	0.	0.	
50,000	.0008	−.0002	
50,000	.0008	−.0002	
100,000	.0012	−.0002	
150,000	.0016	−.0002	
200,000	.0021	−.0002	
50,000	.0007	.....	
100,000	.0012	.....	
150,000	.0016	.....	
200,000	.0021	.....	
150,000	.0016	.....	
100,000	.0012	.....	
50,000	.0008	−.0002	
250,000	.0025	−.0004	
300,000	.0030	−.0005	
350,000	.0034	−.0008	
50,000	.0004	.....	

CAST IRON TRACK BLOCK—Continued.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
100,000	.0011	.....	
150,000	.0015	.....	
200,000	.0020	.....	
250,000	.0025	.....	
300,000	.0029	.....	
250,000	.0025	.....	
200,000	.0020	.....	
150,000	.0016	.....	
100,000	.0012	.....	
50,000	.0005	.....	
40,000	.0002	.....	
30,000	−.0001	.....	
20,000	−.0004	.....	
10,000	−.0008	.....	
5,000	.....	−.0009	
10,000	−.0007	.....	
20,000	−.0005	.....	
30,000	−.0001	.....	
40,000	+.0002	.....	
50,000	.0004	.....	
40,000	.0002	.....	
30,000	−.0001	.....	
20,000	−.0005	.....	
10,000	−.0008	.....	
5,000	.....	−.0009	
			Track block removed from the testing machine and contact surface of each block examined by means of surface plate and curvature gauge. No appreciable change in the shape of the surfaces detected. Track block returned to the machine and readjusted against the rocker block and test resumed.
5,000	0.	0.	Initial load. Micrometer reset at zero.
10,000	0.	.....	
20,000	0.	.....	
30,000	.0001	.....	
40,000	.0002	.....	
50,000	.0004	.....	
40,000	.0002	.....	
30,000	.0001	.....	
20,000	0.	.....	
10,000	−.0002	.....	
5,000	.....	−.0002	
50,000	.0004	.....	
5,000	.....	−.0002	
100,000	.0008	−.0003	
200,000	.0016	−.0004	
300,000	.0025	−.0004	
1,000	.....	−.0006	
5,000	.....	−.0004	
100,000	.0006	.....	
200,000	.0016	.....	
800,00	.0024	.....	
400,000	.0032	.....	
300,000	.0024	.....	
200,000	.0016	.....	
100,000	.0007	.....	
5,000	.....	−.0005	
50,000	.0001	−.0005	
400,000	.0032	−.0005	
400,000	.0032	−.0005	
450,000	.0035	−.0005	
500,000	.0039	−.0007	
50,000	.0001	.....	
100,000	.0006	.....	
150,000	.0011	.....	
200,000	.0016	.....	
150,000	.0012	.....	
100,000	.0007	.....	
50,000	.0001	−.0007	
550,000	.0042	−.0006	
600,000	.0045	−.0006	
650,000	.0049	−.0006	
700,000	.0052	−.0006	
750,000	.0055	−.0006	
800,000	.0059	−.0006	
50,000	.0005	.....	
100,000	.0010	.....	
150,000	.0015	.....	
200,000	.0020	.....	
250,000	.0024	.....	
300,000	.0028	.....	
350,000	.0032	.....	

CAST IRON TRACK BLOCK—Continued.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
400,000	.0085		
350,000	.0082		
300,000	.0028		
250,000	.0024		
200,000	.0020		
150,000	.0015		
100,000	.0010		
50,000	.0005		
5,000		−.0006	
200,000	.0020		
400,000	.0035		
600,000	.0047		
800,000	.0059		
600,000	.0048		
400,000	.0037		
200,000	.0021		
5,000		−.0006	
5,000		−.0002	After resting 16 hours under 5,000 pounds load.
10,000	−.0001		
20,000	0.		
30,000	+.0008		
40,000	.0005		
50,000	.0006	−.0002	
100,000	.0010	−.0002	
200,000	.0018	−.0002	
300,000	.0027	−.0002	
400,000	.0035	−.0002	
500,000	.0042	−.0002	
600,000	.0047+	−.0002	
700,000	.0058	−.0002	
800,000	.0059	−.0002	
5,000		+.0004	After resting under the initial load 30 hours.
50,000	.0007		
100,000	.0011		(Temperature of room lower.)
150,000	.0015		
200,000	.0020		
250,000	.0023		
300,000	.0028		
250,000	.0024		
200,000	.0020		
150,000	.0015		
100,000	.0011		
50,000	.0007	.0003	
100,000	.0011		
200,000	.0020		
400,000	.0035		
600,000	.0048		
800,000	.0060		
600,000	.0049		
400,000	.0037		
200,000	.0022		
100,000	.0012	.0004	
Blocks readjusted.			
5,000	.0002		
50,000	.0004		
100,000	.0008		
200,000	.0016		
300,000	.0025		
400,000	.0032		
500,000	.0039		
600,000	.0044		
700,000	.0050		
800,000	.0055		
700,000	.0051		
600,000	.0045		
500,000	.0040		
400,000	.0034		
300,000	.0027		
200,000	.0019		
100,000	.0010		
50,000	.0004	−.0004	
50,000	.0008		
100,000	.0008		
200,000	.0017		
300,000	.0025		
400,000	.0033		
300,000	.0026		
200,000	.0018		
100,000	.0009		
50,000	.0004	−.0004	

No. 10444a.

CAST STEEL (MIDVALE) TPACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0004	− .0001	
100,000	.0008	− .0001	
150,000	.0012	− .0001	
200,000	.0015	− .0001	
250,000	.0019	− .0001	
300,000	.0022	− .0001	
350,000	.0025	− .0001	
400,000	.0028	− .0002	
450,000	.0031	− .0002	
500,000	.0033	− .0002	
550,000	.0036	− .0002	
600,000	.0038	− .0002	
650,000	.0041	− .0002	
700,000	.0042	− .0002	
750,000	.0045	− .0002	
800,000	.0047	− .0002	
50,000	.0004	.....	
100,000	.0008	.....	
200,000	.0015	.....	
300,000	.0022	.....	
400,000	.0028	.....	
500,000	.0034	.....	
600,000	.0038	.....	
700,000	.0043	.....	
800,000	.0047	.....	
700,000	.0043	.....	
600,000	.0039	.....	
500,000	.0034	.....	
400,000	.0029	.....	
300,000	.0023	.....	
200,000	.0016	.....	
100,000	.0009	.....	
50,000	.0004	− .0005	
Rested under initial load 16 hours.			
5,000	+.0001	.....	
50,000	.0005	.....	
100,000	.0010	.....	
200,000	.0016	.....	
300,000	.0023	.....	
400,000	.0029	.....	
300,000	.0023	.....	
200,000	.0017	.....	
100,000	.0010	.....	
50,000	.0005	+ .0001	
100,000	.0010	.....	
200,000	.0017	.....	
300,000	.0023	.....	
400,000	.0029	.....	
500,000	.0034	.....	
600,000	.0039	.....	
700,000	.0044	.....	
800,000	.0048	.....	
700,000	.0044	.....	
600,000	.0039	.....	
500,000	.0035	.....	
400,000	.0030	.....	
300,000	.0024	.....	
200,000	.0017	.....	
100,000	.0010	+.0001	

No. 10445a.

FORGED STEEL TRACK BLOCK.

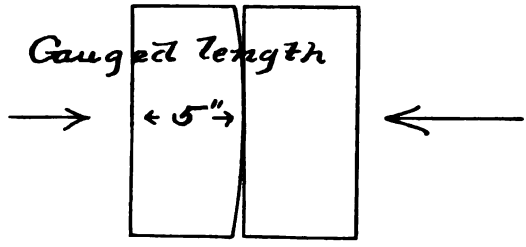
Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0006	0.	
100,000	.0008	0.	
150,000	.0012	0.	
200,000	.0014	0.	
250,000	.0018	0.	
300,000	.0021	−.0001	
350,000	.0024	−.0001	
400,000	.0027	−.0001	
450,000	.0029	−.0001	
500,000	.0031	−.0001	
550,000	.0034	−.0001	
600,000	.0037	−.0001	
650,000	.0039	−.0001	
700,000	.0042	−.0001	
750,000	.0044	−.0001	
800,000	.0045	−.0001	
50,000	.0008	.....	
100,000	.0007	.....	
200,000	.0015	.....	
300,000	.0022	.....	
400,000	.0027	.....	
500,000	.0032	.....	
600,000	.0037	.....	
700,000	.0042	.....	
800,000	.0045	.....	
700,000	.0042	.....	
600,000	.0037	.....	
500,000	.0032	.....	
400,000	.0027	.....	
300,000	.0022	.....	
200,000	.0015	.....	
100,000	.0007	.....	
50,000	.0008	−.0001	

No. 10446a.

CAST STEEL (EVERETT) TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0008	0.	
100,000	.0007	−.0001	
150,000	.0012	−.0001	
200,000	.0015	−.0001	
250,000	.0018	−.0001	
300,000	.0021	−.0001	
350,000	.0024	−.0001	
400,000	.0026	−.0001	
450,000	.0029	−.0001	
500,000	.0032	−.0001	
550,000	.0035	0.	
600,000	.0038	+.0001	
650,000	.0041	.0002	
700,000	.0044	.0003	
750,000	.0047	.0005	
800,000	.0050	.0007	
50,000	.0012	.....	
100,000	.0016	.....	
200,000	.0023	.....	
300,000	.0029	.....	
400,000	.0034	.....	
500,000	.0038	.....	
600,000	.0043	.....	
700,000	.0047	.....	
800,000	.0051	.....	
700,000	.0048	.....	
600,000	.0044	.....	
500,000	.0040	.....	
400,000	.0036	.....	
300,000	.0030	.....	
200,000	.0024	.....	
100,000	.0017	.....	
50,000	.0013	.0008	

MICROMETER OBSERVATIONS TAKEN ON THE ROCKER BLOCK.



Gauged length of 5″ established on top surface, one extremity being ¼″ from the element making contact with the Track Block.

No. 10446b.

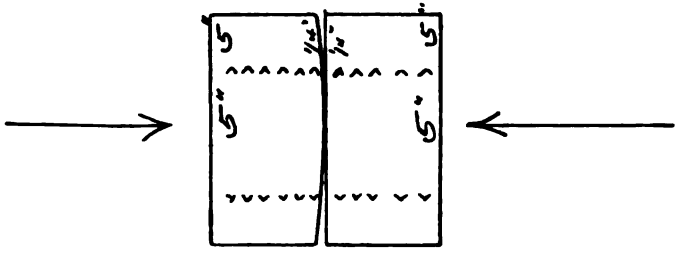
CAST STEEL (EVERETT) BLOCK USED.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
100,000	.0002	.....	
200,000	.0007	.....	
300,000	.0012	.....	
400,000	.0016	.....	
500,000	.0021	.....	
600,000	.0024	.....	
700,000	.0029	.....	
800,000	.0032	.....	
700,000	.0029	.....	
600,000	.0025	.....	
500,000	.0021	.....	
400,000	.0017	.....	
300,000	.0013	.....	
200,000	.0009	.....	
100,000	.0002	− .0001	

Gauged length of 5″ established on the track block opposite position in preceding test, one extremity being ¼″ from the face next the rocker block.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
100,000	.0004	.....	
200,000	.0009	.....	
300,000	.0014	.....	
400,000	.0019	.....	
500,000	.0022	.....	
600,000	.0026	.....	
700,000	.0031	.....	
800,000	.0035	.....	
700,000	.0031	.....	
600,000	.0028	.....	
500,000	.0024	.....	
400,000	.0019	.....	
300,000	.0015	.....	
200,000	.0010	.....	
100,000	.0005	.0004	
800,000	.0035	.0004	

TRANSVERSE GAUGED LENGTHS.



Gauged lengths, 5" each.

Everett cast steel track block used in this and subsequent experiments.

No. 10446c.

OBSERVATIONS ON CAST STEEL TRACK BLOCK.

[Transverse gauged length taken ¼" from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	.0002	.....	Movement is an inward one, a contraction in width of the block.
400,000	.0003	.....	
600,000	.0005	.....	
800,000	.0007	.....	
600,000	.0005	.....	
400,000	.0003	.....	
200,000	.0002	.....	
5,000	0.	0.	

[Transverse gauged length taken 1¼" from the working face.]

5,000	0.	0.	Initial load.
200,000	0.	.....	Movement is an outward one, an expansion in width of the block.
400,000	0.	.....	
600,000	.0002	.....	
800,000	.0004	.....	
600,000	.0002	.....	
400,000	.0001	.....	
200,000	0.	.....	
5,000	0.	0.	

[Transverse gauged length taken ¾" from the working face.]

5,000	0.	0.	Initial load.
200,000	0.	.....	No lateral movement shown.
400,000	0.	.....	
600,000	0.	.....	
800,000	0.	.....	
400,000	0.	.....	
5,000	.....	.0001	

OBSERVATIONS ON THE ROCKER BLOCK.

[Transverse gauged length taken ¼" from the working face.]

5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement, a contraction in width of the block.
400,000	.0004	.....	
600,000	.0005	.....	
800,000	.0007	.....	
600,000	.0005	.....	
400,000	.0004	.....	
200,000	.0002	.....	
5,000	0.	0.	

OBSERVATIONS ON THE ROCKER BLOCK—Continued.

[Transverse gauged length taken ¼″ from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	0.	.....	No lateral movement shown.
400,000	0.	.....	
600,000	0.	.....	
800,000	0.	.....	
400,000	0.	.....	
5,000	0.	0.	

[Transverse gauged length taken 1¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	0.	.....	Movement, an expansion in width of the block.
400,000	.0001	.....	
600,000	.0003	.....	
800,000	.0004	.....	
600,000	.0003	.....	
400,000	.0003	.....	
200,000	.0001	.....	
5,000	0.	0.	

[Transverse gauged length taken 2¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement, an expansion in width of the block.
400,000	.0003	.....	
600,000	.0005	.....	
800,000	.0007	.....	
600,000	.0005	.....	
400,000	.0004	.....	
200,000	.0002	.....	
5,000	0.	.....	

[Transverse gauged length taken 3¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0003	.....	Movement, an expansion in width of the block.
400,000	.0005	.....	
600,000	.0007	.....	
800,000	.0009	.....	
600,000	.0008	.....	
400,000	.0006	.....	
200,000	.0003	.....	
5,000	.....	0.	

[Transverse gauged length taken 4¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0002	.....	Movement, an expansion in width of the block.
400,000	.0005	.....	
600,000	.0008	.....	
800,000	.0010	.....	
600,000	.0008	.....	
400,000	.0006	.....	
200,000	.0004	.....	
5,000	.....	0.	

[Transverse gauged length taken 5″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0002	.....	Movement, an expansion in width of the block.
400,000	.0006	.....	
600,000	.0008	.....	
800,000	.0010	.....	
600,000	.0009	.....	
400,000	.0007	.....	
200,000	.0004	.....	
5,000	.....	0.	

OBSERVATIONS ON THE ROCKER BLOCK—Continued.

[Observations repeated on transverse gauged length ¼″ from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement, a contraction in width of the block.
400,000	.0003	.....	
600,000	.0004	.....	
800,000	.0004	.....	
600,000	.0004	.....	
400,000	.0003	.....	
200,000	.0001	.....	
5,000	.....	0.	
800,000	.0004	.....	
5,000	.....	0.	

OBSERVATIONS RENEWED ON TRACK BLOCK.

[Transverse gauged length taken ¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0002	.....	Movement, a contraction in width of the block.
400,000	.0004	.....	
600,000	.0006	.....	
800,000	.0007	.....	
600,000	.0006	.....	
400,000	.0004	.....	
200,000	.0002	.....	
5,000	.....	0.	

[Transverse gauged length taken 5″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0003	.....	Movement, an expansion in width of the block.
400,000	.0005	.....	
600,000	.0009	.....	
800,000	.0012	.....	
600,000	.0010	.....	
400,000	.0008	.....	
200,000	.0005	.....	
5,000	.....	0.	

[Transverse gauged length taken 3¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0008	.....	Movement, an expansion in width of the block.
400,000	.0005	.....	
600,000	.0008	.....	
800,000	.0010	.....	
600,000	.0008	.....	
400,000	.0006	.....	
200,000	.0004	.....	
5,000	.....	.0001	

OBSERVATIONS RESUMED ON THE ROCKER BLOCK.

[Transverse gauged length now reduced to 3″ and taken ¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement, a contraction in width of the block.
400,000	.0003	.....	
600,000	.0004	.....	
800,000	.0005	.....	
480,000	.0003	.....	
5,000	.....	0.	

OBSERVATIONS RESUMED ON THE ROCKER BLOCK—Continued.

[Gauged length now increased to 9" and taken ¼" from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement, a contraction in width of the block.
400,000	.0003	.....	
600,000	.0005	.....	
800,000	.0006	.....	
400,000	.0004	.....	
5,000	.....	0.	

[Gauged length 9" long taken 5" from the working face.]

5,000	0.	0.	Initial load.
200,000	.0005	.....	Movement, an expansion in width of the block.
400,000	.0009	.....	
600,000	.0012	.....	
800,000	.0016	.....	
600,000	.0015	.....	
400,000	.0011	.....	
200,000	.0007	.....	
5,000	.....	0.	

OBSERVATIONS ON TRACK BLOCK AGAIN MADE.

[Gauged length of 9" taken 5" from the working face.]

5,000	0.	0.	Initial load.
200,000	.0004	.....	Movement, an expansion in width of the block.
400,000	.0008	.....	
600,000	.0012	.....	
800,000	.0014	.....	
600,000	.0013	.....	
400,000	.0010	.....	
200,000	.0006	.....	
5,000	.....	.0001	

OBSERVATIONS ON THE ROCKER BLOCK.

[Measurements taken by means of a caliper over the length of the rocker block, in a direction parallel to the contact elements and ¼" from the working face, at the middle of the width of the block.]

Applied loads.	Longitudinal extension.	Remarks.
Pounds.	*Inch.*	
5,000	0.	Initial load.
400,000	.0007	
800,000	.0017	
5,000	.0002	
800,000	.0017	
5,000	0.	

[Longitudinal measurements taken at a distance of 2¼" from the working face. Taken in a line with one extremity of the original 5" gauged length established for measuring the direct compression of the blocks.]

5,000	0.	
800,000	.0008	
5,000	0.	
800,000	.0008	
5,000	0.	

[Caliper returned to position on the length taken ¼" from the working face.]

5,000	0.	Initial load.
800,000	.0016	
5,000	0.	

COMPRESSION TESTS OF ROCKER BLOCK AND TRACK BLOCKS.

SECOND SERIES.

BLOCKS OF REDUCED LENGTHS.

The rocker block and track blocks were each cut into two parts and tests made on parts which were 6″ long. The tests were conducted in the same order as in the original series which were made when the blocks were 12″ long, first loading the rocker block with the cast iron track block. Compressions were measured on a gauged length of 5″, taken at the middle of the widths of the blocks. After each increment the stress was reduced to the initial load and the sets determined. There were apparently minus sets developed under the earlier loads, which reached a maximum of —″.0003 after 250,000 pounds had been applied. At 550,000 pounds the set was in a plus direction, and from this load onward there was a progressive gain, which, after the application of 800,000 pounds, was ″.0019.

A series of observations was next taken under ascending and descending stresses. The second application of 800,000 pounds increased the set only ″.0001. The blocks, however, having taken jointly a set of ″.0020, a part of which set was in each block, it was necessary to rescrape the rocker block to restore its working face to the prescribed curvature, 114″ radius. The other three track blocks were in turn loaded in the same manner as above described. The permanent sets developed under the maximum load applied, 800,000 pounds, the capacity of the testing machine, were as follows:

Tests made with the—	Set.
	Inch.
Cast iron track block	.0019
Cast steel (Midvale) track block	.0012
Forged steel track block	.0008
Cast steel (Everett) track block	.0041

Observations on the lateral movement of the blocks next followed, ending with further measurements of the direct compression, or the apparent direct compression of the rocker block with the cast steel (Everett) track block on gauged lengths at the middle of the width of the blocks, near the sides and at intermediate places.

Referring to the numerical values obtained on the direct compression of the blocks, in comparison with the results found when the blocks were of full length, it appears that the relative compression is less now than in the earlier tests, comparing the effects according to the loads per linear inch of contact surface. The following tables are prepared to illustrate the comparative behavior of the blocks when of full length, and at the present time when shortened one-half. The

figures pertaining to the 6″ blocks are deduced from the series of ascending and descending loads.

OBSERVATIONS ON COMPRESSION OF THE ROCKER BLOCK.

USED WITH CAST IRON TRACK BLOCK.

[Gauged length of 5″, taken 2¼″ on each block.]

Applied loads.	Blocks 12″ long.	Blocks 6″ long.	Remarks.
Pounds.	*Inch.*	*Inch.*	
100,000	0.	0.	Initial reading.
200,000	.0008	.0011	
300,000	.0017	.0020	
400,000	.0024	.0028	
500,000	.0031	.0037	
600,000	.0036	.0046	
700,000	.0042	.0052	
800,000	.0047	.0061	

USED WITH CAST STEEL (MIDVALE) TRACK BLOCK.

100,000	0.	0.	Initial reading.
200,000	.0007	.0009	
300,000	.0014	.0016	
400,000	.0020	.0023	
500,000	.0025	.0029	
600,000	.0030	.0036	
700,000	.0034	.0043	
800,000	.0039	.0049	

USED WITH FORGED STEEL TRACK BLOCK.

100,000	0.	0.	Initial reading.
200,000	.0006	.0009	
300,000	.0013	.0016	
400,000	.0019	.0022	
500,000	.0023	.0028	
600,000	.0029	.0035	
700,000	.0034	.0041	
800,000	.0037	.0047	

USED WITH CAST STEEL (EVERETT) TRACK BLOCK.

100,000	0.	0.	Initial reading.
200,000	.0008	.0006	
300,000	.0014	.0012	
400,000	.0019	.0017	
500,000	.0025	.0022	
600,000	[a].0030	.0027	
700,000	[a].0034	.0032	
800,000	[a].0036	.0037	

[a] Sets deducted; resilient movement given.

An inspection of the above tables shows the compressive strains in the half blocks proportionally less than in the whole blocks, the difference almost disappearing in the case of the Everett cast steel track block. The condition of the Everett block at the time this comparison is made in some degree explains the behavior displayed, since it had received a greater permanent set than the other blocks, thereby increasing the contact surface.

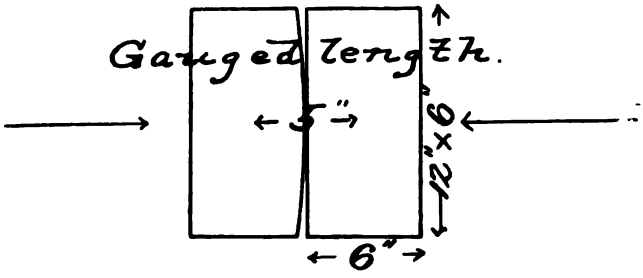
Measurements of the strains in a lateral direction indicate some of

the resultant movements. Both blocks considered as beams show decided bending under load, as evinced by the lateral movements observed on the gauged lengths established normal to the direction of loading, and taken at varying distances of ¼″ to 5″ from the working faces. The neutral axes for the lateral strains were eccentric, as before observed, but appeared to be slightly more removed from the working faces than in the earlier series of tests, in this respect the blocks of reduced lengths showing greater freedom in bending. The depths of the blocks necessarily influence their bending resistance, which would be further modified by the support received from the buttresses of the testing machine. The distortion in these tests is thought to be largely due, however, to the dimensions of the blocks, insufficient depth of metal being present to resist the pressures applied. Both blocks bend and develop lateral strains not unlike, although the rocker block rested against an auxiliary buttress 4″ deep, while the track block was reenforced by a buttress 10½″ deep, each clamped in the heads of the testing machine.

Observations on direct compression, as shown by the measurements on gauged lengths established parallel to the direction of loading, were renewed. Across the middle of the width of the blocks, on a gauged length of 10″, the compressive strain observed was ″.0079 for a load of 800,000 pounds. One-fourth inch from side A the movement was ″.0139, and the same distance from side B there was a movement of ″.0157, while at intermediate places the movements were ″.0100 and ″.0114. As the ends closed ″.0139 and ″.0157, respectively, the mean being ″.0148, and the middle closed ″.0079, there is a difference shown of ″.0069, which is taken to indicate the aggregate bending of both blocks. The closing in at opposite ends was not alike. This depends upon the accuracy of the adjustment of the blocks in the testing machine initially, and upon their symmetrical yielding when permanent sets are developed by the higher loads.

In order to illustrate the effect of change of position, the adjusting screws of the testing machine were moved one turn toward side A, whereupon the resilient movements at sides A and B became ″.0120 and ″.0180, respectively. A change in position in the opposite direction of one turn of the screws as before, and the movements at sides A and B now were ″.0158 and ″.0121, respectively.

GENERAL RESULTS.



Compression measured on a gauged length of 5″, one-half of the distance taken on each block, and at the middle of the width,

FIRST APPLICATIONS OF LOADS TO BLOCKS OF REDUCED LENGTHS.

[Loads between 100,000 and 800,000 pounds.]

Applied loads.	Compression. Rocker block tested with track blocks of—			
	Cast iron.	Cast steel (Midvale).	Forged steel.	Cast steel (Everett).
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*
100,000	0.	0.	0.	0.
150,000	.0006	.0006	.0005	.0005
200,000	.0011	.0011	.0009	.0009
250,000	.0017	.0016	.0014	.0013
300,000	.0022	.0020	.0017	.0016
350,000	.0027	.0023	.0021	.0020
400,000	.0031	.0027	.0024	.0023
450,000	.0036	.0030	.0027	.0026
500,000	.0042	.0034	.0030	.0029
550,000	.0048	.0038	.0034	.0034
600,000	.0054	.0041	.0037	.0040
650,000	.0060	.0045	.0041	.0050
700,000	.0067	.0050	.0044	.0057
750,000	.0073	.0055	.0049	.0065
800,000	.0080	.0061	.0054	.0072

The above compressions include the permanent sets developed by the several blocks when the loads were applied for the first times, sets generally appearing after loads of 500,000 pounds and upwards were applied.

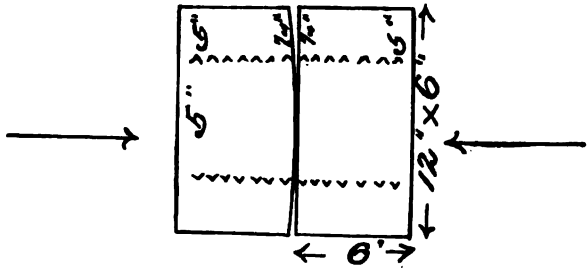
SECOND APPLICATIONS OF LOADS TO BLOCKS OF REDUCED LENGTHS.

[Loads between 100,000 and 800,000 pounds.]

Applied loads.	Compression. Rocker block tested with track blocks of—			
	Cast iron.	Cast steel (Midvale).	Forged steel.	Cast steel (Everett).
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*
100,000	0.	0.	0.	0.
200,000	.0011	.0009	.0009	.0006
300,000	.0020	.0016	.0016	.0012
400,000	.0028	.0023	.0022	.0017
500,000	.0037	.0029	.0028	.0022
600,000	.0046	.0036	.0035	.0027
700,000	.0052	.0043	.0041	.0032
800,000	.0061	.0049	.0047	.0037

LATERAL MOVEMENT OF BLOCKS.

Gauged lengths.



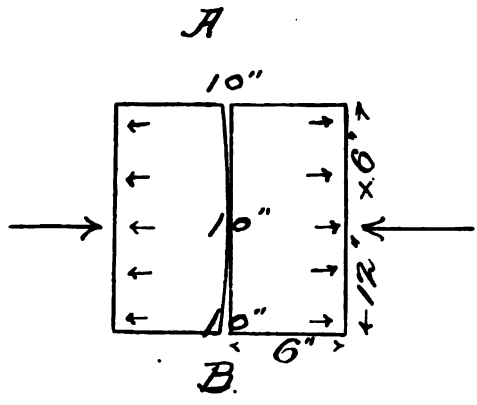
The direction of the lateral movement is stated in the notations at the foot of the tables.

Applied loads.	Observations on rocker block on 5″ transverse gauged lengths taken at the following distances from the working face:						
	¼ inch.	¾ inch.	1¼ inches.	2¾ inches.	3¼ inches.	4¼ inches.	5 inches.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
5,000	0.	0.	0.	0.	0.	0.	0.
800,000	.0016	.0003	.0004	.0010	.0014	.0015	.0019
	Inward.				Outward.		

Applied loads.	Observations on cast steel (Everett) track block on 5″ transverse gauged lengths taken at the following distances from the working face:						
	¼ inch.	¾ inch.	1¼ inches.	2¾ inches.	3¼ inches.	4¼ inches.	5 inches.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
5,000	0.	0.	0.	0.	0.	0.	0.
800,000	.0021	.0006	.0003	.0009	.0014	.0016	.0021
	Inward.				Outward.		

Comparison of the Direct Compression of the Blocks taken at Different Places on their Widths.

Gauged lengths.



ROCKER BLOCK USED WITH CAST STEEL (EVERETT) TRACK BLOCK.

[Gauged lengths, 10″.]

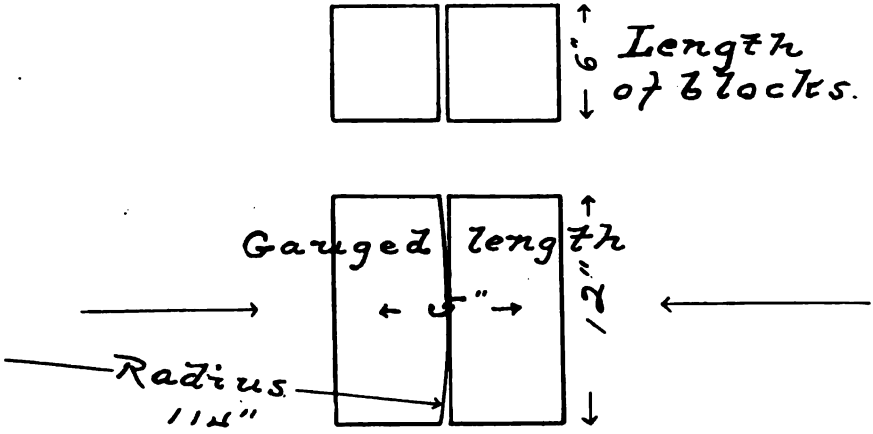
Applied loads.	Compression on gauged lengths at—				
	¼ inch from side A.	3¼ inches from side A.	Middle of width.	3¼ inches from side B.	¼ inch from side B.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
5,000	0.	0.	0.	0.	0.
800,000	.0139	.0100	.0079	.0114	.0157
Adjusting screws of testing machine moved one turn toward side A.					
800,000	.0120				.0180
Adjusting screws of testing machine moved one turn toward side B.					
800,000	.0158				.0121

SECOND SERIES OF COMPRESSION TESTS OF A CAST STEEL ROCKER BLOCK, OF 114″ RADIUS OF CURVATURE, WITH TRACK BLOCKS OF DIFFERENT METALS.

DETAILS.

BLOCKS OF REDUCED LENGTHS.

The rocker block and track blocks were cut into two parts, 6″ and 5″.3 long, respectively. Test were resumed on the parts 6″ long each.



CAST STEEL (MIDVALE) ROCKER BLOCK USED WITH TRACK BLOCKS OF DIFFERENT METALS.

No. 10443d.

CAST IRON TRACK BLOCK..

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0006	−.0001	
100,000	.0013	−.0001	
150,000	.0019	−.0001	
200,000	.0024	−.0002	
250,000	.0030	−.0003	
300,000	.0035	−.0003	
350,000	.0040	−.0003	
400,000	.0044	−.0003	
450,000	.0049	−.0002	
500,000	.0055	−.0001	
550,000	.0061	+.0002	
600,000	.0067	.0005	Rested under 25,000 pounds 16 hours. No change in permanent set.
650,000	.0073	.0007	
700,000	.0080	.0011	
750,000	.0086	.0014	

CAST-STEEL (MIDVALE) ROCKER BLOCK, ETC.—Continued.

CAST IRON TRACK BLOCK—Continued.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
800,000	.0093	.0019	
100,000	.0033	.....	
200,000	.0044	.....	
300,000	.0053	.....	
400,000	.0061	.....	
500,000	.0070	.....	
600,000	.0079	.....	
700,000	.0085	.....	
800,000	.0094	.....	
700,000	.0086	.....	
600,000	.0080	.....	
500,000	.0073	.....	
400,000	.0065	.....	
300,000	.0056	.....	
200,000	.0047	.....	
100.000	.0036	.0020	

An examination of the working faces of the rocker and track blocks showed the surfaces to be concave ".001 + each, the result of the permanent set acquired during the test.

Placing tissue paper (about ".0012 thick) between working faces of rocker and track blocks and applying pressure, the impression left on the paper measured about 2".45 and 3".20 wide for loads of 400,000 and 800,000 pounds, respectively.

ROCKER BLOCK RESCRAPED TO PRESCRIBED CURVATURE, 114" RADIUS.

No. 10444d.

CAST STEEL (MIDVALE) TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0007	0.	
100,000	.0014	0.	
150,000	.0020	0.	
200,000	.0025	0.	
250,000	.0030	0.	
300,000	.0034	0.	
350,000	.0037	0.	
400,000	.0041	0.	
450,900	.0044	0.	
500,000	.0048	+.0001	
550,000	.0052	.0001	
600,000	.0055	.0002	
650,000	.0059	.0004	
700,000	.0064	.0006	
750,000	.0069	.0009	
800,000	.0075	.0012	
100,000	.0026	.....	
200,000	.0035	.....	
300,000	.0042	.....	
400,000	.0049	.....	
500,000	.0055	.....	
600,000	.0062	.....	
700,000	.0069	.....	
800,000	.0075	.....	
700,000	.0070	.....	
600,000	.0064	.....	
500,000	.0057	.....	
400,000	.0050	.....	
300,000	.0044	.....	
200,000	.0036	.....	
100,000	.0027	.0014	

No. 10445d.

FORGED STEEL TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0007	0.	
100,000	.0012	0.	
150,000	.0017	0.	
200,000	.0021	+.0001	
250,000	.0026	.0001	
300,000	.0029	.0001	
350,000	.0033	.0001	
400,000	.0036	.0001	
450,000	.0039	.0001	
500,000	.0042	.0001	
550,000	.0046	.0001	
600,000	.0049	.0002	
650,000	.0053	.0002	
700,000	.0056	.0004	
750,000	.0061	.0006	
800,000	.0066	.0008	
100,000	.0020	.....	
200,000	.0029	.....	
300,000	.0036	.....	
400,000	.0042	.....	
500,000	.0048	.....	
600,000	.0055	.....	
700,000	.0061	.....	
800,000	.0067	.....	
700,000	.0062	.....	
600,000	.0056	.....	
500,000	.0051	.....	
400,000	.0044	.....	
300,000	.0038	.....	
200,000	.0031	.....	
100,000	.0022	.0010	

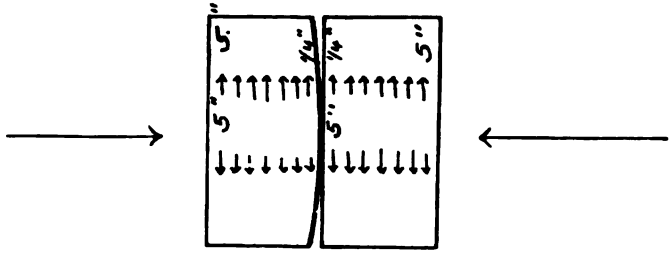
No. 10446d.

CAST STEEL (EVERETT) TRACK BLOCK.

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
50,000	.0008	0.	
100,000	.0012	0.	
150,000	.0017	0.	
200,000	.0021	0.	
250,000	.0025	0.	
300,000	.0028	0.	
350,000	.0032	0.	
400,000	.0035	0.	
450,000	.0038	0.	
500,000	.0041	.0001	
550,000	.0046	.0006	
600,000	.0052	.0011	
650,000	.0062	.0020	
700,000	.0069	.0026	
750,000	.0077	.0033	
800,000	.0084	.0041	
100,000	.0049	.....	
200,000	.0055	.....	
300,000	.0061	.....	
400,000	.0066	.....	
500,000	.0071	.....	
600,000	.0076	.....	
700,000	.0081	.....	
800,000	.0086	.....	
700,000	.0083	.....	
600,000	.0079	.....	
500,000	.0074	.....	
400,000	.0069	.....	
300,000	.0061	.....	
200,000	.0058	.....	
100,000	.0052	.0043	

LATERAL MOVEMENT OF BLOCKS.

Gauged lengths.



OBSERVATIONS ON CASTS TEEL (EVERETT) TRACK BLOCK; TRANSVERSE GAUGED LENGTH 5".

No. 10446e.

[¼" from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	.0010	.....	Movement is an inward one, a contraction in the width of the block.
400,000	.0015	.....	
600,000	.0019	.....	
800,000	.0021	.....	
600,000	.0019	.....	
400,000	.0015	.....	
200,000	.0010	.....	
5,000	.....	0.	

[5" gauged length, ¼" from the working face.]

5,000	0.	0.	Initial load.
200,000	.0004	.....	Movement is a contraction in width.
400,000	.0006	.....	
600,000	.0007	.....	
800,000	.0006	.....	
600,000	.0006	.....	
400,000	.0005	.....	
200,000	.0005	0.	
200,000	.0004	.....	
400,000	.0005	.....	
600,000	.0006	.....	
800,000	.0006	.....	
600,000	.0006	.....	
400,000	.0005	.....	
200,000	.0004	.....	
100,000	.0003	.....	
50,000	.0001	0.	

[5" gauged length, 1¼" from the working face.]

5,000	0.	0.	Initial load.
200,000	+ .0001	.....	Movement is a contraction in width at 200,000 pounds, return to original length at 400,000 pounds, and an expansion at 600,000 and 800,000 pounds.
400,000	0.	.....	
600,000	− .0001	.....	
800,000	− .0003	.....	
600,000	− .0001	.....	
400,000	0.	.....	
200,000	+ .0001	0.	

OBSERVATIONS ON CAST STEEL (EVERETT) TRACK BLOCK, ETC.—Continued.

[5″ gauged length, 2½″ from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	
200,000	0.	.....	Movement is an expansion in width.
400,000	.0008	.....	
600,000	.0006	.....	
800,000	.0009	.....	
600,000	.0006	.....	
400,000	.0004	.....	
200,000	.0001	.....	
100,000	.0001	0.	

[5″ gauged length, 3½″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0002	.....	Movement is an expansion in width.
400,000	.0006	.....	
600,000	.0010	.....	
800,000	.0014	.....	
600,000	.0011	.....	
400,000	.0007	.....	
200,000	.0004	0.	

[5″ gauged length 4½″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0004	.....	Movement is an expansion in width.
400,000	.0008	.....	
600,000	.0013	.....	
800,000	.0016	.....	
600,000	.0014	.....	
400,000	.0011	.....	
200,000	.0006	0.	

[5″ gauged length 5″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0005	.....	Movement is an expansion in width.
400,000	.0010	.....	
600,000	.0016	.....	
800,000	.0021	.....	
600,000	.0019	.....	
400,000	.0015	.....	
200,000	.0009	.....	
100,000	.0005	.....	
50,000	.0003	0.	

OBSERVATIONS ON THE CAST STEEL ROCKER BLOCK; TRANSVERSE GAUGED LENGTH 5″.

[Taken ¼″ from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	.0005	.....	Movement is a contraction in width.
400,000	.0009	.....	
600,000	.0013	.....	
800,000	.0016	.....	
600,000	.0014	.....	
400,000	.0010	.....	
200,000	.0005	0.	

OBSERVATIONS ON THE CAST STEEL ROCKER BLOCK, ETC.—Continued.

[5″ gauged lenth ¼″ from the working face.]

Applied loads.	Lateral movement.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement is a contraction in width.
400,000	.0001	.....	
600,000	.0001	.....	
800,000	.0003	.....	
600,000	.0003	.....	
400,000	.0002	.....	
200,000	.0001	0.	

[5″ gauged length 1¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0001	.....	Movement is an expansion in width.
400,000	.0002	.....	
600,000	.0003	.....	
800,000	.0004	.....	
600,000	.0003	.....	
400,000	.0002	.....	
200,000	.0001	0.	

[5″ gauged length 2¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0002	.....	Movement is an expansion in width.
400,000	.0005	.....	
600,000	.0008	.....	
800,000	.0010	.....	
600,000	.0008	.....	
400,000	.0005	.....	
200,000	.0003	0.	

[5″ gauged length 3¼″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0004	.....	Movement is an expansion in width.
400,000	.0007	.....	
600,000	.0010	.....	
800,000	.0014	.....	
600,000	.0011	.....	
400,000	.0008	.....	
200,000	.0004	0.	

[5″ gauged length 4¼″ from the working face.]

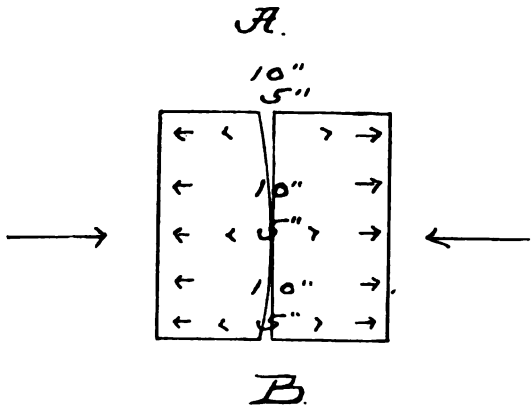
5,000	0.	0.	Initial load.
200,000	.0004	.....	Movement is an expansion in width.
400,000	.0008	.....	
600,000	.0011	.....	
800,000	.0015	.....	
600,000	.0013	.....	
400,000	.0010	.....	
200,000	.0005	0.	

[5″ gauged length 5″ from the working face.]

5,000	0.	0.	Initial load.
200,000	.0005	.....	Movement is an expansion in width.
400,000	.0011	.....	
600,000	.0016	.....	
800,000	.0019	.....	
600,000	.0017	.....	
400,000	.0013	.....	
200,000	.0007	.....	
100,000	.0004	.....	
50,000	.0002	0.+	

Observations on the Direct Compression of the Blocks Renewed.

Gauged lengths.



CAST STEEL (EVERETT) TRACK BLOCK, 5″ GAUGED LENGTH.

No. 10446f.

[Side A, ¼″ from sides of blocks.]

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
100,000	.0024	.....	
200,000	.0043	.....	
300,000	.0058	.....	
400,000	.0074	.....	
500,000	.0088	.....	
600,000	.0102	.....	
700,000	.0116	.....	
800,000	.0129	.....	
700,000	.0118	.....	
600,000	.0106	.....	
500,000	.0094	.....	
400,000	.0080	.....	
300,000	.0065	.....	
200,000	.0047	.....	
100,000	.0027	.0001	

[5″ gauged length, side B, ¼″ from the sides of the blocks.]

5,000	0.	0.	Initial load.
100,000	.0028	.....	
200,000	.0048	.....	
300,000	.0067	.....	
400,000	.0085	.....	
500,000	.0101	.....	
600,000	.0117	.....	
700,000	.0133	.....	
800,000	.0148	.....	
700,000	.0136	.....	
600,000	.0121	.....	
500,000	.0107	.....	
400,000	.0091	.....	
300,000	.0073	.....	
200,000	.0053	.....	
100,000	.0030	0.	

CAST STEEL (EVERETT) TRACK BLOCK, 5″ GAUGED LENGTH—Continued.

[10″ gauged length, side A, ¼″ from sides of the blocks.]

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
100,000	.0025	.....	
200,000	.0045	.....	
300,000	.0063	.....	
400,000	.0079	.....	
500,000	.0093	.....	
600,000	.0109	.....	
700,000	.0126	.....	
800,000	.0139	0.	

[10″ gauged length at middle of width of blocks.]

5,000	0.	0.	Initial load.
100,000	.0011	.....	
200,000	.0021	.....	
300,000	.0031	.....	
400,000	.0041	.....	
500,000	.0051	.....	
600,000	.0060	.....	
700,000	.0069	.....	
800,000	.0079	0.	

[10″ gauged length, side B, ¼″ from sides of the blocks.]

5,000	0.	0.	Initial load.
100,000	.0027	.....	
200,000	.0049	.....	
300,000	.0069	.....	
400,000	.0088	.....	
500,000	.0106	.....	
600,000	.0124	.....	
700,000	.0140	.....	
800,000	.0157	0.	

[10″ gauged length, 3½″ from side A.]

5,000	0.	0.	Initial load.
100,000	.0016	.....	
200,000	.0030	.....	
300,000	.0043	.....	
400,000	.0054	.....	
500,000	.0067	.....	
600,000	.0078	.....	
700,000	.0090	.....	
800,000	.0100	0.	

[10″ gauged length, 3½″ from side B.]

5,000	0.	0.	Initial load.
100,000	.0017	.....	
200,000	.0034	.....	
300,000	.0048	.....	
400,000	.0063	.....	
500,000	.0075	.....	
600,000	.0087	.....	
700,000	.0100	.....	
800,000	.0114	0.	

Horizontal adjusting screws of testing machine holder moved one turn toward side A.

[Observations repeated on 10″ gauged length ¼″ from side A.]

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
400,000	.0065	.....	
800,000	.0127	.0007	
800,000	.0131	.0011	

[10″ gauged length ¼″ from side B.]

5,000	0.	0.	Initial load.
400,000	.0104	.....	
800,000	.0181	.0001	

Adjusting screws moved two turns in the direction B, the blocks now being one turn toward B beyond their original position.

[10″ gauged length ¼″ from side A.]

Applied loads.	Compression.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	
5,000	0.	0.	Initial load.
400,000	.0140	.....	
800,000	.0192	.0031	
800,000	.0194	.0036	

[10″ gauged length ¼″ from side B.]

5,000	0.	0.	Initial load.
400,000	.0066	.....	
800,000	.0125	.0004	

TENSILE TESTS—SPECIMENS FROM ROCKER BLOCK AND TRACK BLOCKS.

No. 7455.

Specimen from cast steel rocker block.
Marks, R.
Diameter ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000133	.000133	0.	0.	
10,000	.000267	.000134	.....	.....	
20,000	.000533	.000266	0.	0.	
30,000	.001067	.000434	.000033	.000033	
31,000	.001100	.000033	.....	.....	
32,000	.001133	.000033	.....	.....	Elastic limit.
33,000	.001200	.000067	.....	.....	
34,000	.001267	.000067	.....	.....	
35,000	.001333	.000066	.000133	.000100	
36,000	.001500	.000167	.....	.....	
37,000	.001600	.000100	.....	.....	
38,000	.001800	.000200	.....	.....	
40,000	.002783	.000983	.....	.....	
42,000	.004333	.001600	.....	.....	
44,000	.005900	.001567	.....	.....	
46,000	.007500	.001600	.....	.....	
48,000	.009167	.001667	.....	.....	
50,000	.011000	.001833	.....	.....	
75,920	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	75,920
Elastic limit per square inch of original section	do...	32,000
Elongation per inch after rupture	inch..	.053
Elongation per inch under strain at elastic limit	do...	.001133
Reduction in diameter at point of rupture	do...	.024
Reduction in area after rupture, per cent of original section		8.4
Position of rupture		1. "8 from neck
Character of broken surface		granular, silvery luster
Elongation of inch sections		".05, ".06*, ".05

No. 7456.

Specimen from cast iron track block.
Marks, C I.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
2,000	.000067	.000067	.....	.....	
3,000	.000100	.000033	.....	.....	
4,000	.000133	.000033	.....	.....	
5,000	.000167	.000034	0.	0.	
6,000	.000267	.000100	.....	.....	
7,000	.000300	.000033	.....	.....	
8,000	.000367	.000067	.....	.....	
9,000	.000400	.000033	.....	.....	
10,000	.000467	.000067	0.	0.	
11,000	.000567	.000100	.....	.....	
12,000	.000633	.000066	.....	.....	
13,000	.000667	.000034	.....	.....	
14,000	.000733	.000066	.....	.....	
15,000	.000833	.000100	.000033	.000033	
16,000	.000933	.000100	.....	.....	
17,000	.001000	.000067	.....	.....	
18,000	.001067	.000067	.....	.....	
19,000	.001133	.000066	.....	.....	
20,000	.001233	.000100	.000133	.000100	
21,000	.001333	.000100	.....	.....	
22,000	.001433	.000100	.....	.....	
23,000	.001533	.000100	.....	.....	
24,000	.001633	.000100	.....	.....	
25,000	.001733	.000100	.000300	.000167	
26,000	.001900	.000167	.....	.....	
27,000	.002067	.000167	.....	.....	
28,000	.002233	.000166	.....	.....	
29,000	.002400	.000167	.....	.....	
30,000	.002700	.000300	.000833	.000533	
33,120	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section ..... pounds.. 33,120
Position of rupture ..... 1".45 from neck
Character of broken surface ..... granular, gray, granitic

No. 7457.

Specimen from cast steel (Midvale) track block.
Marks, M.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000300	.000200			
20,000	.000667	.000367	0.	0.	
30,000	.001067	.000400	.000067	.000067	
31,000	.001100	.000033			
32,000	.001167	.000067			
33,000	.001233	.000066			
34,000	.001267	.000034			Elastic limit.
35,000	.001333	.000066	.000133	.000066	
36,000	.001433	.000100			
38,000	.001567	.000134			
39,000	.001633	.000066			
40,000	.001867	.000234	.000500	.000367	
41,000	.002167	.000300			
42,000	.003067	.000900			
43,000	.003833	.000766			
44,000	.004733	.000900			
46,000	.006333	.001600			
48,000	.008033	.001700			
50,000	.009567	.001534			
88,400					Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	88,400
Elastic limit per square inch of original section	do...	84,000
Elongation per inch after rupture	inch..	.113
Elongation per inch under strain at elastic limit	do...	.001267
Reduction in diameter at point of rupture	do...	.044
Reduction in area after rupture, per cent of original section		15.0
Position of rupture		".85 from neck
Character of broken surface		granular, silvery luster
Elongation of inch sections		".13*, ".11, ".10

No. 7458.

Specimen from forged steel track block.
Marks, F.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	0.	0.	
10,000	.000333	.000233	.....	.....	
20,000	.000700	.000367	0.	0.	
30,000	.001100	.000400	0.	0.	
31,000	.001133	.000033	.....	.....	
32,000	.001200	.000067	.....	.....	
33,000	.001233	.000033	.....	.....	
34,000	.001267	.000034	.....	.....	
35,000	.001300	.000033	.....	.....	Elastic limit.
36,000	.001400	.000100	.....	.....	
	.004100	.002700	.....	.....	
37,000	.006333	.002233	.....	.....	
38,000	.007267	.000934	.....	.....	
39,000	.007767	.000500	.....	.....	
40,000	.008600	.000833	.....	.....	
41,000	.009267	.000667	.....	.....	
42,000	.010333	.001066	.....	.....	
43,000	.011000	.000667	.....	.....	
44,000	.012367	.001367	.....	.....	
45,000	.012733	.000366	.....	.....	
81,520	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	81,520
Elastic limit per square inch of original section	do...	35,000
Elongation per inch after rupture	inch..	.21
Elongation per inch under strain at elastic limit	do...	.001300
Reduction in diameter at point of rupture	do...	.114
Reduction in area after rupture, per cent of original section		36.4
Position of rupture		1".06 from neck
Character of broken surface		granular 75 per cent, silky 25 per cent
Elongation of inch sections		".14, ".21, ".28*

No. 7459.

Specimen from cast steel (Everett) track block.
Marks, E.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	Elongation per inch.	Successive elongation per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000167	.000167	0.	0.	
10,000	.000333	.000166	.....	.....	
20,000	.000733	.000400	0.	0.	
30,000	.001100	.000367	0.	0.	
31,000	.001133	.000033	.....	.....	
32,000	.001200	.000067	.....	.....	
33,000	.001233	.000033	.....	.....	
34,000	.001267	.000034	.....	.....	
35,000	.001300	.000033	.....	.....	Elastic limit.
36,000	.001400	.000100	.....	.....	
37,000	.002333	.000933	.....	.....	
	.006333	.004000	.....	.....	
38,000	.007400	.001067	.....	.....	
39,000	.007833	.000433	.....	.....	
40,000	.008667	.000834	.....	.....	
41,000	.009333	.000666	.....	.....	
42,000	.010500	.001167	.....	.....	
43,000	.011100	.000600	.....	.....	
44,000	.011900	.000800	.....	.....	
45,000	.013000	.001100	.....	.....	
81,960	.....	.....	.....	.....	Tensile strength.

General summary.

Tensile strength per square inch of original section	pounds..	81,960
Elastic limit per square inch of original section	do...	35,000
Elongation per inch after rupture	inch..	.223
Elongation per inch under strain at elastic limit	do...	.001300
Reduction in diameter at point of rupture	do...	.104
Reduction in area after rupture, per cent of original section		33.5
Position of rupture		1".40 from neck
Character of broken surface		silky 80 per cent, granular 20 per cent
Elongation of inch sections		".23, ".29*, ".15

TABULATION OF TENSILE SPECIMENS FROM ROCKER BLOCK AND TRACK BLOCKS.

No. of test.	Mark on specimen.	Diameter.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
		Inch.	*Sq. inch.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*		" " "
7455	R.....	.564	.25	32,000	75,920	5.3	8.4	Granular, silvery luster.	.05, .06*, .05
7456	C. 1 ...	.564	.25	.....	33,120	.....	.....	Granular, gray, granitic.	
7457	M	.564	.25	34,000	88,400	11.3	15.0	Granular, silvery luster.	.13*, .11, .10
7458	F.....	.564	.25	35,000	81,520	21.0	36.4	Granular 75 per cent, silky 25 per cent.	.14, .21, .28*
7459	E.....	.564	.25	35,000	81,960	22.3	33.5	Silky 80 per cent, granular 20 per cent.	.23, .29*, .15

COMPRESSION TESTS.—SPECIMENS FROM ROCKER BLOCK AND TRACK BLOCKS.

No. 1178.

Specimen from cast steel rocker block.
Marks, R.
Total length, 5.″
Diameter, 1″.00.
Sectional area, .7854 square inch.
Gauged length, 4.″

Applied loads per square inch.	Compression per inch.	Successive compression per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000250	.000250	.000025	.000025	
10,000	.000475	.000225	.000050	.000025	
11,000	.000500	.000025	.....	.....	
12,000	.000525	.000025	.....	.....	
13,000	.000550	.000025	.....	.....	
14,000	.000600	.000050	.....	.....	
15,000	.000650	.000050	.000050	0.	
16,000	.000675	.000025	.....	.....	
17,000	000700	.000025	.....	.....	
18,000	.000725	.000025	.....	.....	
19,000	.000750	.000025	.....	.....	
20,000	.000800	.000050	.000100	.000050	
21,000	.000825	.000025	.....	.....	
22,000	.000875	.000050	.....	.....	
23,000	.000900	.000025	.....	.....	
24,000	.000950	.000050	.....	.....	
25,000	.000975	.000025	.000100	0.	
26,000	.001000	.000025	.....	.....	
27,000	.001025	.000025	.....	.....	
28,000	.001075	.000050	.....	.....	
29,000	.001100	.000025	.....	.....	
30,000	.001125	.000025	.000125	.000025	
31,000	.001175	.000050	.....	.....	
32,000	.001225	.000050	.....	.....	
33,000	.001250	.000025	.....	.....	
34,000	.001300	.000050	.....	.....	
35,000	.001350	.000050	.000225	.000100	
36,000	.001400	.000050	.....	.....	Elastic limit, approximate.
37,000	.001450	.000050	.....	.....	
38,000	.001525	.000075	.....	.....	
39,000	.001650	.000125	.....	.....	
40,000	.001975	.000325	.000750	.000525	
41,000	.003375	.001400	.....	.....	
42,000	.005000	.001625	.....	.....	
43,000	.005750	.000750	.....	.....	
44,000	.006350	.000600	.....	.....	
45,000	.007125	.000775	.005625	.004875	
83,300	.....	.....	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1177.

Specimen from cast iron track block.
Marks, CI.
Total length, 6″.
Diameter, 1″.00.
Sectional area, .7854 square inch.
Gauged length, 4″.

Applied loads per square inch.	Compression per inch.	Successive compression per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
2,000	.000075	.000075	.....	.....	
3,000	.000125	.000050	.....	.....	
4,000	.000150	.000025	.....	.....	
5,000	.000225	.000075	0.	0.	
6,000	.000275	.000050	.....	.....	
7,000	.000325	.000050	.....	.....	
8,000	.000350	.000025	.....	.....	
9,000	.000425	.000075	.....	.....	
10,000	.000475	.000050	0.	0.	
11,000	.000500	.000025	.....	.....	
12,000	.000575	.000075	.....	.....	
13,000	.000625	.000050	.....	.....	
14,000	.000675	.000050	.....	.....	
15,000	.000725	.000050	0.	0.	
16,000	.000775	.000050	.....	.....	
17,000	.000825	.000050	.....	.....	
18,000	.000875	.000050	.....	.....	
19,000	.000925	.000050	.....	.....	
20,000	.000975	.000050	.000025	.000025	
21,000	.001025	.000050	.....	.....	
22,000	.001100	.000075	.....	.....	
23,000	.001175	.000075	.....	.....	
24,000	.001225	.000050	.....	.....	
25,000	.001300	.000075	.000075	.000050	
26,000	.001350	.000050	.....	.....	
27,000	.001425	.000075	.....	.....	
28,000	.001475	.000050	.....	.....	
29,000	.001550	.000075	.....	.....	
30,000	.001625	.000075	.000200	.000125	
31,000	.001700	.000075	.....	.....	
32,000	.001825	.000125	.....	.....	
33,000	.001925	.000100	.....	.....	
34,000	.002000	.000075	.....	.....	
35,000	.002100	.000100	.000450	.000250	
36,000	.002250	.000150	.....	.....	
37,000	.002400	.000150	.....	.....	
38,000	.002500	.000100	.....	.....	
39,000	.002675	.000175	.....	.....	
40,000	.002925	.000250	.000875	.000425	
41,000	.003150	.000225	.....	.....	
42,000	.003350	.000200	.....	.....	
43,000	.003600	.000250	.....	.....	
44,000	.003850	.000250	.....	.....	
45,000	.004250	.000400	.001825	.000950	
46,000	.004575	.000325	.....	.....	
47,000	.004875	.000300	.....	.....	
48,000	.005225	.000350	.....	.....	
49,000	.005600	.000375	.....	.....	
50,000	.006050	.000450	.003450	.001625	
102,100	.....	.....	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1179.

Specimen from cast steel (Midvale) track block.
Marks, M.
Total length, 5″.
Diameter, 1″.00.
Sectional area, .7854 square inch.
Gauged length, 4″.

Applied loads per square inch.	Compression per inch.	Successive compression per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000100	.000100	.000025	.000025	
10,000	.000275	.000175	.000100	.000075	
11,000	.000360	.000075	.....	.....	
12,000	.000400	.000050	.....	.....	
13,000	.000425	.000025	.....	.....	
14,000	.000475	.000050	.....	.....	
15,000	.000500	.000025	.000100	0.	
16,000	.000500	0.	.....	.....	
17,000	.000500	0.	.....	.....	
18,000	.000600	.000100	.....	.....	
19,000	.000650	.000050	.....	.....	Elastic limit.
20,000	.000825	.000175	.000300	.000200	
21,000	.001050	.000225	.....	.....	
22,000	.001625	.000575	.....	.....	
23,000	.002100	.000475	.....	.....	
24,000	.002750	.000650	.....	.....	
25,000	.003775	.001025	.003025	.002725	
26,000	.004600	.000825	.....	.....	
27,000	.005750	.001150	.....	.....	
28,000	.007050	.001300	.....	.....	
29,000	.008050	.001000	.....	.....	
30,000	.009075	.001025	.008100	.005075	
57,800	.....	.....	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1180.

Specimen from forged steel track block.
Marks, F.
Total length, 6″.
Diameter, 1″.00.
Sectional area, .7854 square inch.
Gauged length, 4″.

Applied loads per square inch.	Compression per inch.	Successive compression per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000075	.000075	0.	0.	
10,000	.000200	.000125	.....	.....	
15,000	.000350	.000150	.....	.....	
20,000	.000500	.000150	0.	0.	
25,000	.000650	.000150	.....	.....	
30,000	.000850	.000200	0.	0.	
35,000	.001150	.000300	.....	.....	Elastic limit.
36,000	.001250	.000100	.....	.....	
37,000	.001400	.000150	.....	.....	
38,000	.002250	.000850	.....	.....	
39,000	.002875	.000625	.....	.....	
40,000	.003625	.000750	.002275	.002275	
41,000	.004150	.000525	.....	.....	
42,000	.004750	.000600	.....	.....	
43,000	.005700	.000950	.....	.....	
44,000	.006500	.000800	.....	.....	
45,000	.007225	.000725	.005650	.005375	
79,300	.....	.....	.....	.....	Ultimate strength.

Failed by triple flexure.

No. 1181.

Specimen from cast steel (Everett) track block.
Marks, E.
Total length, 6″.
Diameter, 1″.00.
Sectional area, .7854 square inch.
Gauged length, 4″.

Applied loads per square inch.	Compression per inch.	Successive compression per inch.	Permanent set.	Successive permanent set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
1,000	0.	0.	0.	0.	Initial load.
5,000	.000050	.000050	0.	0.	
10,000	.000250	.000200	0.	0.	
11,000	.000275	.000025	.....	.....	
12,000	.000300	.000025	.....	.....	
13,000	.000350	.000050	.....	.....	
14,000	.000375	.000025	.....	.....	
15,000	.000425	.000050	.000025	.000025	
16,000	.000450	.000025	.....	.....	
17,000	.000500	.000050	.....	.....	
18,000	.000525	.000025	.....	.....	
19,000	.000550	.000025	.....	.....	Elastic limit.
20,000	.000650	.000100	.000125	.000100	
21,000	.000925	.000275	.....	.....	
22,000	.001400	.000475	.....	.....	
23,000	.001775	.000375	.....	.....	
24,000	.002750	.000975	.....	.....	
25,000	.003500	.000750	.002725	.002600	
26,000	.004500	.001000	.....	.....	
27,000	.005525	.001025	.....	.....	
28,000	.006700	.001175	.....	.....	
29,000	.007650	.000950	.....	.....	
30,000	.008500	.000850	.007625	.004900	
57,000	.....	.....	.....	.....	Ultimate strength.

Failed by triple flexure.

TABULATION OF COMPRESSIVE SPECIMENS FROM ROCKER BLOCK AND TRACK BLOCKS.

No. of test.	Mark on specimen.	Total length.	Diameter.	Sectional area.	Elastic limit per square inch.	Compressive strength per square inch.	Manner of failure.
		Inches.	*Inch.*	*Sq. inch.*	*Pounds.*	*Pounds.*	
1178	R.....	5	1.00	.7854	[a]37,000	83,300	Triple flexure.
1177	C. I.....	6	1.00	.7854	.....	102,100	Do.
1179	M.....	5	1.00	.7854	19,000	57,800	Do.
1180	F.....	6	1.00	.7854	35,000	79,300	Do.
1181	E.....	6	1.00	.7854	19,000	57,000	Do.

[a] Appropriate.

WROUGHT IRON.

TENSILE TESTS OF WROUGHT IRON.

FIRST SERIES.

Specimens, 24 inches long. Twelve inches between jaws of testing machine.

COMMON REFINED IRON.

Shape.	Nominal size.	Actual dimensions.	Sectional area.	Tensile strength. Total.	Per square inch.	Mean.	Elongation in 10 inches	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Inch.	*Inch.*	*Sq. inch.*	*Pounds*	*Pounds*	*Pounds*	*Per cent.*	*Inch. Sq. inch.*	*Per cent.*		" " " " " " " " " "
Round..	¼ diameter..	.371 diameter.	.108	5,840	54,070	.....	16.6	.29 diameter=.066.	38.9	Fibrous; broke outside gauged length.	.16, .16, .17, .16, .16, .14, .14, .16, .19, .22
Do....	.....do.....	.376 diameter.	.111	5,800	52,250	.....	21.1	.29 diameter=.066.	40.5	.....do.....	.17, .18, .21, .25, .25, .21, .19, .17, .25, .23
Do....	.....do.....	.374 diameter.	.110	5,860	53,280	53,200	20.7	.28 diameter=.062.	43.6	Fibrous.....	.15, .18, .17. .18, .21, .18, .19, .22, .39*, .20
Do....	¼ diameter..	.507 diameter.	.202	10,410	51,540	.....	15.7	.38 diameter=.113.	44.0	Fibrous; broke outside gauged length.	.15, .16, .16, .17, .17, .13, .08, .16, .19, .20
Do....	.....do.....	.503 diameter.	.199	10,500	52,760	.....	20.3	.39 diameter=.119.	40.2	Fibrous.	.16, .16, .18, .19, .19, .38*, .18, .16, .23, .20
Do....	.....do.....	.506 diameter.	.203	10,530	51,870	52,060	23.9	.38 diameter=.113.	44.3	.....do.....	.21, .19, .20, .19, .23, .25, .23, .44*, .23, .22
Do....	½ diameter..	.633 diameter.	.315	16,100	51,110	.....	21.4	.51 diameter=.204.	35.3	.....do.....	.18, .17, .18, .18, .18, .22, .23, .42*, .19, .19
Do....	.....do.....	.634 diameter.	.316	16,210	51,300	.....	19.2	.52 diameter=.212.	33.5	Fibrous; broke outside gauged length.	.17, .17, .17, .18, .24, .19, .19, .19, .23, .19
Do....	.....do.....	.635 diameter.	.317	16,150	50,950	51,120	20.1	.50 diameter=.196.	38.2	Fibrous.....	.16, .16, .16, .18, .19, .19, .18, .24, .36*, .19
Do....	¾ diameter..	.758 diameter.	.451	23,750	52,660	.....	22.0	.62 diameter=.302.	33.0	Fibrous; granular spots.	.17, .18, .24, .23, .29, .34, *.20, .19, .18, .18
Do....	.....do.....	.759 diameter.	.452	23,900	52,880	.....	23.9	.59 diameter=.273.	39.6	.....do.....	.19, .20, .23, .22, .44*, .24, .24, .23, .20, .20
Do....	.....do.....	.759 diameter.	.452	23,890	52,850	52,800	26.3	.59 diameter=.273.	39.6	.....do.....	.22, .23, .22, .23, .29, .26, .33, .41, .23, .21

BEST PUDDLED IRON.

Round..	¼ diameter..	.253 diameter .	.0503	2,950	58,650	.....	12.4	.21 diameter=.035 .	30.4	Fibrous.....	.11, .11, .10, .10, .12, .13, .16, .16, .14, .11
Do....	½ diameter..	.370 diameter .	.1075	5,620	52,280	.....	22.2	.29 diameter=.066 .	38.6	.....do.....	.22, .21, .21, .25, .36*, .21, .24, .19, .18, .17
Do....	$\frac{7}{16}$ diameter..	.431 diameter .	.1459	8,270	56,680	.....	15.1	.32 diameter=.080 .	45.2	.....do.....	.13, .15, .15, .16, .15, .13, .11, .15, .19, .19
Do....	½ diameter..	.499 diameter .	.1956	10,550	53,940	.....	22.4	.38 diameter=.113 .	42.2	.....do.....	.19, .18, .17, .19, .23, .43*, .24, .21, .21, .19
Do....	⅝ diameter..	.88 diameter ..	.608	30,100	49,510	.....	15.9	.74 diameter=.430 .	29.3	Fibrous; broke in jaw.	.17, .16, .17, .16, .17*, .15, .15, .15, .16, .15
Do....	1 diameter..	1.01 diameter .	.801	42,400	52,930	.....	25.0	.83 diameter=.541 .	32.5	Fibrous.....	.26, .25, .22, .20, .19, .20, .23, .32*, .38*, .25

TENSILE TESTS OF WROUGHT IRON—Continued.

BEST PUDDLED IRON—Continued.

Shape.	Nominal size.	Actual dimensions.	Sectional area.	Tensile strength. Total.	Tensile strength. Per square inch.	Tensile strength. Mean.	Elongation in 10 inches	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.									
	Inch.	*Inch.*	*Sq. inch.*	*Pounds*	*Pounds*	*Pounds*	*Per cent.*	*Inch. Sq. inch.*	*Per cent.*		"	"	"	"	"	"	"	"	"	"
Square	½ square	.259×.261	.0676	3,380	50,000	.....	10.7	.24×.24=.058	14.2	Fibrous	.10,	.09,	.08,	.10,	.12,	.20*,	.09,	.08,	.10,	.11
Do	⅜ square	.388×.394	.1529	7,630	49,900	.....	20.0	.32×.31=.099	35.3	.....do	.18,	.18,	.18,	.18,	.19,	.18,	.19,	.21,	.24,	.27
Do	½ square	.439×.441	.1936	10,170	52,530	.....	22.2	.37×.36=.133	31.3	.....do	.19,	.18,	.18,	.20,	.40*,	.21,	.23,	.22,	.22,	.19
Do	½ square	.63 ×.63	.397	18,800	47,360	.....	15.8	.55×.55=.303	23.7	Fibrous; broke at jaw.	.15,	.17,	.17,	.16,	.16,	.15,	.15,	.15,	.16,	.16
Do	⅝ square	.76×.76	.578	27,950	48,360	.....	24.4	.60×.60=.360	37.7	Fibrous	.22,	.22,	.22,	.21,	.20,	.20,	.24,	.52*,	.22,	.19
Do	¾ square	.87×.87	.757	35,960	47,500	.....	26.4	.69×.69=.476	37.1	Fibrous; oblique	.23,	.26,	.55*,	.28,	.21,	.25,	.24,	.22,	.20,	.20
Do	1 square	1.01×1.00	1.010	50,200	49,700	.....	22.3	.86×.86=.740	26.7	.....do	.20,	.20,	.30,	.37*,	.20,	.18,	.20,	.20,	.18,	.20
Do	1⅛ square	1.11.×1.13	1.254	60,700	48,400	.....	25.8	.91×.91=.828	34.0	Fibrous; broke at jaw.	.24,	.23,	.24,	.24,	.23,	.23,	.24,	.26,	.31,	.36
Do	1¼ square	1.26×1.25	1.575	74,900	47,560	.....	12.0	1.13×1.13=1.277	18.9	Fibrous; granular spots.	.10,	.10,	.10,	.10,	.30,	.10,	.10,	.10,	.10,	.10
Do	1⅜ square	1.37×1.39	1.904	92,800	48,740	.....	21.8	1.18×1.18=1.392	37.3	Fibrous; two large granular spots.	.20,	.20,	.20,	.20,	.28,	.35*,	.21,	.19,	.18,	.17
Flat	1½×½	1.50×.264	.396	20,000	50,500	.....	23.4	1.31×.22=.288	27.3	Fibrous	.19,	.22,	.22,	.20,	.23,	.41*,	.24,	.21,	.21,	.21
Do	.....do	1.50×.264	.396	19,700	49,750	.....	19.7	1.31×.23=.301	24.0	.....do	.14,	.16,	.16,	.22,	.18,	.19,	.19,	.21,	.21,	.31*
Do	.....do	1.50×.264	.396	19,900	50,250	50,170	22.8	1.36×.22=.299	24.5	.....do	.19,	.19,	.20,	.19,	.23,	.25,	.37*,	.24,	.21,	.21
Do	2×½	2.00×.267	.534	24,200	45,320	.....	17.4	1.81×.21=.380	28.8	.....do	.15,	.15,	.15,	.15,	.16,	.15,	.15,	.15,	.21,	.32*
Do	.....do	2.00×.267	.534	24,700	46,260	.....	18.8	1.78×.23=.409	23.4	.....do	.16,	.17,	.17,	.17,	.19,	.17,	.17,	.17,	.20,	.31*
Do	.....do	2.00×.263	.526	21,500	40,870	44,150	7.6	1.89×.22=.416	20.9	Fibrous; defective spot.	.06,	.05,	.06,	.06,	.06,	.06,	.06,	.07,	.22*,	.06
Do	2½×½	2.53×.256	.648	33,300	51,390	.....	16.5	2.37×.23=.545	15.9	Fibrous	.16,	.15,	.15,	.15,	.16,	.16,	.15,	.16,	.17,	.24*
Do	.....do	2.53×.258	.653	32,800	50,230	.....	14.7	2.40×.22=.528	19.1	.....do	.14,	.13,	.14,	.14,	.14,	.15,	.13,	.21*,	.17,	.12
Do	.....do	2.53×.258	.653	33,000	50,540	50,720	14.3	2.38×.22=.524	19.8	.....do	.15,	.14,	.15,	.14,	.14,	.15,	.13,	.14,	.15,	.14
Do	1×¼	1.04×.504	.524	23,100	44,080	.....	20.3	.89×.41=.365	30.4	.....do	.19,	.18,	.21,	.22,	.40*,	.20,	.17,	.16,	.15,	.15
Do	.....do	1.04×.504	.524	22,800	42,520	.....	23.3	.84×.36=.302	42.4	.....do	.23,	.53*,	.25,	.19,	.22,	.17,	.19,	.20,	.18,	.17
Do	.....do	1.04×.504	.524	23,100	44,080	43,560	29.7	.78×.38=.296	43.5	.....do	.22,	.24,	.24,	.31,	.33,	.59*,	.29,	.24,	.27,	.24
Do	1½×¼	1.55×.505	.783	34,300	43,810	.....	26.8	1.26×.37=.466	40.5	Fibrous; small granular spots.	.20,	.22,	.21,	.23,	.22,	.21,	.23,	.26,	.37,	.53*
Do	.....do	1.55×.506	.784	34,400	43,710	.....	19.4	1.36×.39=.530	32.6	Fibrous	.19,	.18,	.19,	.17,	.20,	.20,	.20,	.20,	.21,	.20
Do	.....do	1.55×.506	.784	34,600	44,130	43,880	26.8	1.34×.43=.476	39.3	.....do	.37,	.30,	.25,	.23,	.24,	.22,	.23,	.22,	.40*,	.22

Do....	2×½.....	2.04× 507	1.084	45,980	44,470	.....	30.4	1.58×.39=.616.....	40.4	.....do.....	.22,	.22,	.26,	.27,	.31,	.41*,	.52*,	.30,	.31,	.22
Do....	.....do.....	2.03×.499	1.013	46,060	45,470	.....	27.5	1.58×.39=.616.....	39.2	Fibrous; small granular spots.	.18,	.19,	.18,	.21,	.24,	.25,	.25,	.29,	.35,	.61*
Do....	.....do.....	2.03×.500	1.015	46,050	45,370	45,100	30.7	1.60×.38=.608.....	40.1	.....do.....	.21,	.22,	.25,	.29,	.33,	.30,	.28,	.53*,	.39,	.27
Do....	2½×½.....	2.50×.504	1.260	59,730	47,400	.....	12.4	2.36×.48=1.133.....	10.1	Fibrous.....	.11,	.10,	.10,	.11,	.11,	.12,	.14,	.23*,	.12,	.10
Do....	.....do.....	2.50×.501	1.253	59,000	47,090	.....	11.0	2.35×.46=1.080.....	13.8	.....do.....	.10,	.08,	.11,	.09,	.10,	.09,	.10,	.11,	.24*,	.08
Do....	.....do.....	2.50×.505	1.263	59,750	47,310	47,270	11.4	2.32×.46=1.067.....	15.5	Fibrous; broke in jaw.	.12,	.12,	.11,	.12,	.11,	.12,	.10,	.12,	.11,	.11
Do....	1×½.....	1.03×.749	.771	37,690	48,890	.....	25.7	.84×.62=.521.....	32.4	Fibrous.....	.20,	.20,	.25,	.38*,	.38*,	.23,	.24,	.26,	.23,	.20
Do....	.....do.....	1.02×.751	.766	37,550	49,020	.....	26.7	.85×.62=.527.....	31.2	.....do.....	.21,	.18,	.21,	.25,	.53*,	.28,	.30,	.27,	.23,	.21
Do....	.....do.....	1.03×.749	.771	37,770	48,990	48,970	25.5	.85×.62=.527.....	31.6	.....do.....	.20,	.20,	.18,	.20,	.22,	.25,	.26,	.24,	.34,	.46*
Do....	1½×½.....	1.50×.752.....	1.128	54,240	48,090	.....	17.3	1.35×.69=.932.....	17.4	.....do.....	.16,	.16,	.17,	.31*,	.16,	.15,	.16,	.15,	.15,	.16
Do....	.....do.....	1.50×.756.....	1.134	53,620	47,280	.....	17.9	1.32×.66=.871.....	23.2	Fibrous; small granular spots.	.18,	.17	.19,	.17,	.17,	.17.	.17,	.19*,	.21,	.17
Do....	.....do.....	1.50×.750.....	1.125	54,450	48,400	47,920	20.1	1.31×.66=.864.....	23.2	.....do.....	.18,	.19,	.17,	.18,	.19,	.18,	.20,	.30*,	.27,	.21
Do....	2×½.....	1.99×.776.....	1.544	77,100	49,930	.....	22.7	1.74×.64=1.114.....	27.8	.....do.....	.23,	.20,	.21,	.30,	.35*,	.22,	.20,	.21,	.19,	.20
Do....	.....do.....	2.00×.774.....	1.548	73,100	47,220	.....	12.3	1.83×.69=1.263.....	18.4	.....do.....	.10,	.09,	.11,	.12,	.16,	.26*,	.10,	.10,	.10,	.09
Do....	.....do.....	2.00×.774.....	1.548	70.700	45,670	47,610	8.2	1.84×.71=1.306.....	15.6	.....do.....	.08,	.08,	.07,	.07,	.09,	.08,	.07,	.08,	.07,	.18*
Do....	2½×½.....	2.60×.746.....	1.939	93,200	48,070	.....	21.9	2.34×.60=1.404.....	27.6	.....do.....	.22,	.21,	.20,	.20,	.22,	.23,	.21,	.32*,	.19,	.19
Do....	.....do.....	2.59×.755.....	1.955	91,600	46,850	.....	27.5	2.19×.60=1.314.....	32.8	.....do.....	.22,	.24,	.25,	.28,	.43*,	.36*,	.25,	.24,	.23,	.25
Do....	.....do.....	2.58×.752.....	1.940	89,900	46,340	47,090	22.7	2.23×.63=1.405.....	27.6	.....do.....	.18,	.18,	.19,	.20,	.20,	.22,	.22,	.24,	.31,	.33*

BURDEN'S BEST IRON.

Round .	½ diameter..	.384 diameter .	.116	5,860	50,520	.....	18.6	.28 diameter=.062 .	46.5	Fibrous; small granular spots.	.15,	.03,	.08,	.16,	.17,	.18,	.20,	.25,	.41*,	.23
Do....	.....do.....	.385 diameter .	.116	5,710	49,220	.....	18.2	.29 diameter=.066 .	43.1	.....do.....	.14,	.15,	.17,	.14,	.17,	.16,	.17,	.22,	.33*,	.17
Do....	.....do.....	.385 diameter .	.116	5,800	50,000	49,910	24.0	.25 diameter=.049 .	57.8	.....do.....	.18,	.17,	.19,	.21,	.25,	.25,	.22,	.41*,	.27,	.25
Do....	¼ diameter..	.506 diameter .	.201	9,340	46,470	.....	28.2	.34 diameter=.091 .	54.7	.....do.....	.22,	.21,	.23,	.24,	.28,	.28,	.53*,	.27,	.33,	.23
Do....	.....do.....	.507 diameter .	.202	9,300	46,040	.....	27.1	.33 diameter=.086 .	57.4	.....do.....	.23,	.24,	.21,	.26,	.25,	.24,	.25,	.52*,	.29,	.22
Do....	.....do.....	.503 diameter .	.199	9,400	47,240	46,580	27.6	.34 diameter=.091 .	54.3	.....do.....	.21,	.22,	.23,	.25,	.28,	.27,	.55*,	.28,	.25,	.22
Do....	⅜ diameter..	.631 diameter .	.313	14,600	46,650	.....	29.9	.38 diameter=.113 .	63.9	.....do.....	.22,	.22,	.26,	.59,	.34,	.24,	.31,	.29,	.29,	.23
Do....	.....do.....	.628 diameter .	.310	14,590	47,070	.....	30.1	.38 diameter=.113 .	63.6	.....do.....	.24,	.27,	.27,	.62,	.31,	.23,	.19,	.26,	.31,	.31
Do....	.....do.....	.630 diameter .	.312	14,530	46,570	46,760	27.9	.39 diameter=.119 .	61.9	.....do.....	.22,	.23,	.23,	.26,	.60*,	.27,	.28,	.25,	.21,	.24
Flat	1×½.....	1.04×.246	.256	12,980	50,700	.....	25.6	.82×.17=.139.....	45.7	Fibrous.....	.23,	.23,	.27,	.23,	.23,	.21.	.22,	.25,	.25,	.44*
Do....	.....do.....	1.04×.245	.255	13,100	51,370	.....	26.2	.84×.17=.143.....	43.9	Fibrous; oblique....	.25,	.24,	.28,	.27,	.25,	.24,	.24,	.21,	.21,	.43*
Do....	.....do.....	1.05×.245	.257	13,150	51,170	51,080	23.9	.83×.17=.141.....	45.1	Fibrous.....	.26,	.47*,	.25,	.22,	.19,	.20,	.20,	.20,	.20,	.20
Do....	1½×½.....	1.53×.252	.386	17,360	44,970	.....	28.0	1.80×.19=.247.....	36.0	Fibrous; oblique ...	.23,	.23,	.28,	.32,	.27,	.25,	.27,	.45*,	.29,	.21
Do....	.....do.....	1.54×.254	.391	17,130	43,810	.....	24.5	1.30×.19=.247.....	36.8	.....do.....	.23,	.43*,	.21,	.20,	.21,	.25,	.27,	.22,	.21,	.22
Do....	.....do.....	1.53×.253	.387	17,280	44,650	44,480	25.9	1.25×.20=.250.....	35.4	Fibrous.....	.22,	.23,	.23,	.25,	.47*,	.31,	.23,	.22,	.22,	.21

TENSILE TESTS OF WROUGHT IRON—Continued.

BURDEN'S BEST IRON—Continued.

Shape.	Nominal size.	Actual dimensions.	Sectional area.	Tensile strength. Total.	Tensile strength. Per square inch.	Tensile strength. Mean.	Elongation in 10 inches	Area at fracture.	Contraction of area.	Apearance of fracture.	Elongation of inch sections.
	Inch.	*Inch.*	*Sq. inch.*	*Pounds*	*Pounds*	*Pounds*	*Per cent.*	*Inch. Sq. inch.*	*Per cent.*		" " " " " " " " " "
Round..	2×½.....	2.04×.241	.492	23,000	46,750	.....	17.5	1.78×.20=.356.....	27.6	Fibrous.....	.17, .16, .19, .18, .19, .16, .16, .17, .17, .20*
Do....	.....do	2.05×.240	.492	23,020	46,790	.....	17.0	1.82×.20=.364.....	26.0	.....do	.18, .18, .17, .17, .17, .18, .15, .16, .18, .16
Do....	.....do	2.04×.239	.488	22,950	47,030	46,860	21.6	1.81×.19=.344.....	29.5	Fibrous; broke in jaw.	.26, .30, .24, .24, .21, .20, .18, .18, .19, .16
Do....	2½×½.....	2.48×.241	.598	26,760	44,750	.....	25.5	2.05×.19=.390.....	34.8	Fibrous.....	.22, .19, .19, .25, .29, .35, .42*, .27, .20, .17
Do....	.....do	2.47×.244	.603	27,400	45,440	.....	25.0	2.13×.20=.426.....	29.4	.....do	.27, .37*, .32, .24, .21, .20, .21, .21, .22, .25
Do....	.....do	2.47×.243	.600	27,400	45,660	45,280	24.6	2.12×.19=.403.....	32.8	.....do	.22, .21, .20, .23, .23, .21, .30, .40*, .23, .23
Do....	1×½.....	1.03×.504	.519	23,090	44,490	.....	29.1	.78×.37=.289.....	44.4	.....do	.27, .26, .31, .28, .53*, .34, .25, .26, .22, .19
Do....	.....do	1.03×.503	.518	23,210	44,690	.....	31.6	.80×.38=.304.....	41.3	.....do	.28, .26, .31, .29, .27, .40, .50*, .32, .30, .28
Do....	.....do	1.03×.501	.516	23,100	44,770	44,650	27.0	.84×.39=.328.....	36.4	.....do	.28, .28, .24, .28, .45*, .27, .26, .25, .25, .24
Do....	1½×½.....	1.54×.503	.775	35,780	46,170	.....	29.2	1.19×.36=.428.....	44.8	Fibrous; granular spots.	.23, .22, .25, .25, .31, .58*, .35, .26, .25, .22
Do....	.....do	1.53×.502	.768	35,800	46,610	.....	31.6	1.13×.35=.396.....	48.4	.....do	.24, .26, .25, .24, .26, .27, .35, .65*, .88, .26
Do....	.....do	1.53×.501	.767	36,270	47,290	46,690	32.1	1.16×.36=.418.....	45.5	.....do	.25, .26, .28, .29, .28, .28, .30, .44, .58*, .30
Do....	2×½.....	2.00×.499	.998	45,610	45,700	.....	31.5	1.64×.39=.640.....	35.9	.....do	.26, .25, .24, .26, .28, .33, .42, .52*, .32, .27
Do....	.....do	2.00×.500	1.000	45,690	45,690	.....	31.4	1.61×.38=.612.....	39.8	.....do	.31, .28, .34, .66*, .34, .25, .25, .24, .25, .22
Do....	.....do	2.00×.501	1.002	45,630	45,540	45,640	24.8	1.68×.38=.638.....	36.3	.....do	.22, .21, .22, .23, .24, .25, .24, .26, .26, .35
Do....	2½×½.....	2.49×.508	1.265	57,440	45,410	.....	32.8	2.00×.37=.740.....	41.5	.....do	.25, .27, .30, .30, .31, .27, .46, .58*, .28, .26
Do....	.....do	2.49×.507	1.262	56,890	45,080	.....	28.4	2.00×.38=.760.....	39.8	.....do	.20, .31, .23, .24, .26, .26, .30, .52*, .35, .27
Do....	.....do	2.49×.507	1.262	57,080	45,230	45,240	31.2	1.94×.36=.698.....	44.7	Fibrous.....	.24, .25, .25, .26, .27, .24, .36, .65*, .34, .26
Do....	1×¾.....	1.01×.760	.768	35,770	46,580	.....	32.0	.76×.54=.410.....	46.6	.....do	.26, .28, .30, .26, .52, .42*, .29, .30, .30, .27
Do....	.....do	1.01×.769	.777	35,970	46,290	.....	29.5	.79×.56=.442.....	43.1	.....do	.26, .24, .24, .36, .52*, .25, .28, .28, .28, .24
Do....	.....do	1.01×.759	.767	35,780	46,650	46,510	30.7	.79×.57=.450.....	41.3	.....do	.25, .26, .25, .27, .29, .26, .26, .27, .49*, .47
Do....	1½×¾.....	1.49×.759	1.131	54,530	48,210	.....	30.9	1.16×.55=.638.....	43.6	Fibrous; granular spots.	.28, .25, .26, .25, .27, .43, .50*, .27, .28, .30
Do....	.....do	1.49×.759	1.131	54,600	48,280	.....	31.5	1.11×.52=.577.....	49.0	.....do	.25, .29, .28, .32, .67*, .31, .26, .29, .26, .22
Do....	.....do	1.49×.757	1.128	53,800	47,690	48,060	27.6	1.18×.53=.625.....	44.6	.....do	.21, .21, .22, .24, .23, .26, .25, .26, .29, .59*

Do	2×⅛	2.03×.751	1.525	72,180	47,350		31.2	1.64×.57=.935	38.7	Fibrous	.36,	.55*,	.30,	.28,	.27,	.26,	.31,	.28,	.27,	.24
Do	do	2.03×.751	1.525	71,120	46,640		28.9	1.62×.56=.907	40.5	Fibrous; granular spots.	.28,	.32,	.63*,	.34,	.26,	.24,	.21,	.22,	.19,	.20
Do	do	2.03×.750	1.523	72,280	47,460	47,150	30.7	1.59×.54=.859	43.6	do	.24,	.25,	.26,	.27,	.28,	.34,	.60*,	.30,	.28,	.25
Do	2½×⅛	2.56×.761	1.948	89,720	46,060		31.9	2.02×.56=1.131	41.9	do	.23,	.24,	.30,	.46,	.60*,	.30,	.29,	.29,	.24,	.24
Do	do	2.56×.763	1.953	89,300	45,720		27.6	2.03×.56=1.137	41.8	do	.20,	.20,	.20,	.21,	.22,	.23,	.28,	.35,	.32,	.55
Do	do	2.56×.768	1.953	89,190	45,670	45,820	31.1	2.07×.56=1.159	40.6	do	.24,	.22,	.27,	.29,	.31,	.33,	.61*,	.33,	.26,	.25

NORWAY IRON.

Round	1 diameter	1.009 diameter	.800	34,390	42,990		25.8	.60 diameter=.283	64.6	Fibrous	.14,	.15,	.16,	.18,	.19,	.21,	.21,	.24,	.30,	.80*
Do	do	1.008 diameter	.798	33,200	41,600		25.5	.61 diameter=.292	63.4	do	.17,	.16,	.18,	.17,	.17,	.16,	.18,	.21,	.39,	.76*
Do	do	do	.798	33,700	42,230	42,970	32.2	.60 diameter=.283	64.5	do	.18,	.22,	.24,	.25,	.26,	.25,	.28,	.36,	.85*,	.33
Flat	1×⅛	1.02×.252	.257	9,970	38,790		16.2	.71×.18=.092	64.2	do	.04,	.04,	.05,	.08,	.10,	.12,	.12,	.20,	.27,	.60*
Do	do	1.02×.245	.250	9,530	38,120		31.2	.70×.12=.084	66.4	do	.23,	.23,	.21,	.20,	.25,	.25,	.36,	.47,	.58*,	.34
Do	do	1.03×.246	.253	10,000	39,530	38,810	19.5	.70×.13=.091	64.0	do	.18,	.14,	.21,	.22,	.23,	.23,	.22,	.18,	.12,	.27
Do	1½×⅛	1.50×.254	.381	16,080	42,070		33.8	1.04×.14=.146	61.7	do	.25,	.22,	.25,	.26,	.27,	.28,	.34,	.38,	.74*,	.39
Do	do	1.50×.252	.378	15,980	42,280		32.1	1.03×.15=.155	59.0	do	.28,	.24,	.26,	.23,	.27,	.26,	.36,	.70*,	.32,	.29
Do	do	1.50×.255	.383	15,860	41,410	41,920	30.7	1.05×.14=.147	61.6	do	.21,	.22,	.25,	.26,	.28,	.31,	.65*,	.37,	.28,	.24
Do	2×⅛	2.01×.236	.474	20,390	43,020		26.5	1.52×.17=.258	45.6	do	.16,	.16,	.18,	.19,	.20,	.21,	.25,	.28,	.35,	.67*
Do	do	2.02×.236	.477	20,400	42,770		30.9	1.53×.15=.230	51.8	do	.24,	.26,	.23,	.27,	.35,	.69*,	.33,	.26,	.24,	.22
Do	do	2.01×.234	.470	20,000	42,550	42,780	30.0	1.49×.16=.238	49.4	do	.17,	.19,	.22,	.24,	.27,	.29,	.37,	.67*,	.29,	.29
Do	2½×⅛	2.52×.264	.665	25,300	38,050		8.8	2.36×.20=.472	29.0	Fibrous; granular streak.	.04,	.06,	.05,	.05,	.06,	.06,	.07,	.06,	.11,	.32*
Do	do	2.52×.253	.638	26,900	42,160		13.1	2.31×.21=.485	24.0	do	.10,	.10,	.10,	.10,	.11,	.10,	.15,	.32*,	.12,	.11
Do	do	2.53×.265	.670	28,100	41,940	40,720	16.8	2.26×.20=.452	32.5	do	.14,	.12,	.12,	.12,	.14,	.12,	.13,	.13,	.25,	.41*
Do	1×⅛	1.02×.500	.510	20,800	40,780		31.5	.60×.27=.162	68.2	Fibrous	.26,	.26,	.23,	.23,	.24,	.27,	.30,	.45,	.65*,	.26
Do	do	1.01×.500	.505	20,570	40,730		25.6	.63×.28=.176	65.1	do	.00,	.05,	.15,	.22,	.28,	.40,	.72*,	.29,	.23,	.22
Do	do	1.01×.504	.509	21,110	41,470	40,990	31.7	.60×.26=.156	69.4	do	.21,	.24,	.22,	.24,	.26,	.30,	.46,	.64*,	.30,	.30
Do	1½×⅛	1.48×.500	.740	32,480	43,890		24.8	1.01×.31=.313	57.7	do	.14,	.15,	.15,	.16,	.18,	.20,	.21,	.25,	.37,	.67*
Do	do	1.49×.505	.752	33,700	44,810	44,350	29.8	1.02×.31=.316	58.0	do	.16,	.16,	.22,	.23,	.25,	.26,	.65*,	.42,	.29,	.34
Do	2×⅛	2.02×.503	1.016	43,210	42,530		24.1	1.41×.30=.423	58.8	do	.20,	.20,	.22,	.24,	.24,	.23,	.24,	.25,	.28,	.31
Do	do	2.02×.506	1.022	43,100	42,170		30.8	1.41×.27=.381	62.7	do	.14,	.19,	.22,	.21,	.26,	.25,	.28,	.32,	.81*,	.40
Do	do	2.08×.503	1.021	43,400	42,510	42,400	34.5	1.55×.27=.419	59.1	do	.26,	.30,	.55,	.72*,	.35,	.29,	.28,	.25,	.23,	.22
Do	2½×⅛	2.51×.494	1.240	56,070	45,220		22.7	2.06×.32=.659	46.9	do	.20,	.19,	.20,	.21,	.22,	.25,	.23,	.27,	.27,	.23
Do	do	2.52×.495	1.247	56,120	45,000		21.5	1.99×.28=.557	55.3	Fibrous; small granular spots.	.20,	.18,	.20,	.19,	.23,	.21,	.22,	.21,	.22,	.29
Do	do	2.52×.501	1.263	54,430	43,100	44,440	30.2	1.89×.31=.586	53.6	do	.19,	.21,	.19,	.23,	.18,	.24,	.24,	.39,	.81*,	.34
Do	1×⅛	1.01×.750	.758	31,600	41,690		35.8	.67×.42=.281	62.9	Fibrous	.26,	.28,	.29,	.31,	.31,	.39,	.82*,	.36,	.29,	.27
Do	do	1.02×.749	.764	31,350	41,030		34.2	.66×.44=.290	62.0	do	.21,	.24,	.27,	.29,	.36,	.83*,	.38,	.30,	.27,	.27
Do	do	1.02×.750	.765	31,290	40,900	41,210	36.3	.61×.42=.256	66.5	do	.24,	.28,	.30,	.28,	.33,	.34,	.48*,	.76*,	.34,	.28

TENSILE TESTS OF WROUGHT IRON—Continued.

NORWAY IRON—Continued.

Shape.	Nominal size.	Actual dimensions.	Sectional area.	Tensile strength. Total.	Per square inch.	Mean.	Elongation in 10 inches	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Inch.	*Inch.*	*Sq.inch.*	*Pounds*	*Pounds*	*Pounds*	*Per cent.*	*Inch. Sq. inch.*	*Per cent.*		" " " " " " " " " "
Flat	1½×⅜	1.52×.735	1.117	43,400	38,850		41.8	1.01×.39=.394	64.7	Fibrous	.29, .30, .32, .38, .41, .38, .49, .89*, .39, .33
Do	do	1.51×.735	1.110	43,300	39,010		36.0	1.02×.41=.418	62.3	do	.22, .23, .24, .27, .27, .30, .35, .40, .93*, .39
Do	do	1.50×.736	1.104	44,120	39,960	39,270	34.0	.99×.45=.446	59.6	do	.21, .23, .22, .27, .27, .31, .28, .34, .40, .87*
Do	2×⅜	2.00×.753	1.506	63,000	41,830		28.8	1.49×.46=.685	54.5	do	.16, .16, .19, .21, .30, .79*, .41, .24, .21, .21
Do	do	2.00×.752	1.504	67,100	44,610		18.5	1.50×.46=.690	54.1	Fibrous; broke in jaw.	.15, .15, .16, .19, .18, .21, .22, .19, .20, .20
Do	do	2.01×.752	1.512	62,500	41,340	42,590	24.9	1.50×.49=.735	51.4	do	.18, .18, .19, .20, .25, .27, .27, .30, .30, .35
Do	2½×⅜	2.55×.761	1.941	79,200	40,800		36.5	1.84×.46=.846	56.4	Fibrous	.23, .26, .26, .27, .30, .28, .92*, .46, .33, .34
Do	do	2.56×.762	1.952	78,600	40,270		36.1	1.83×.45=.824	57.8	do	.21, .21, .25, .23, .28, .30, .49, 92*, .35, .34
Do	do	2.55×.762	1.943	79,200	40,760	40,610	35.5	1.75×.47=.823	57.7	do	.24, .27, .28, .26, .29, .33, .89*, .43, .30, .26

BEST PUDDLED IRON.

[Heated to a bright yellow and cooled in air.]

Flat	1½×½	1.50×.259	.389	19,080	49,050		21.1	1.32×.22=.290	25.5	Fibrous	.17, .22, .20, .19, .21, .22, .20, .22, .23, .25
Do	2½×½	2.53×.255	.645	33,100	51,320		17.6	2.28×.23=.524	18.8	Fibrous; granular streak.	.19, .17, .25*, .18, .17, .16, .15, .15, .18, .16
Do	2½×½	2.50×.497	1.243	61,080	49,100		21.1	2.21×.41=.906	27.1	Fibrous; small granular spots.	.19, .17, .18, .18, .21, .22, .20, .24, .27*, .25
Do	2½×⅜	2.57×.750	1.928	92,900	48,190		22.1	2.27×.66=1.498	22.3	Fibrous; granular spots.	.23, .22, .22, .36*, .21, .19, .19, .20, .19, .20

[Heated to a bright yellow and quenched in oil.]

Do[a] ..	2×½.....	2.00×.257	.514	26,690	51,930	.....	17.7	1.78×.22=.392.....	23.7	Fibrous.....	.14, .15, .17, .18, .18, .18, .20, .18, .19, .20*
Do....	1×½.....	1.04×.500	.520	26,400	50,770	.....	22.4	.87×.40=.348.....	33.1	Fibrous; granular spots; oblique.	.19, .20, .20, .18, .19, .25, .42, .24, .18, .19
Do....	2×½.....	2.03×.497	1.009	54,550	54,060	.....	21.5	1.69×.39=.659.....	34.7	Fibrous; small granular spots.	.18, .17, .18, .14, .22, .33, .38*, .18, .18, .19
Do....	1×⅝.....	1.01×.743	.750	43,770	58,360	.....	20.2	.82×.61=.500.....	33.3	Fibrous; granular spots.	.20, .17, .19, .40*, .29, .16, .15, .17, .15, .14
Do....	1½×⅝.....	1.49×.736	1.097	56,760	51,740	.....	17.9	1.32×.64=.845.....	23.0	.....do	.16, .18, .17, .19, .16, .15, .18, .28*, .21, .16
Do....	2×⅝.....	1.99×.768	1.528	78,900	51,640	.....	20.5	1.75×.67=1.173.....	23.2	.....do	.21, .19, .19, .23, .20, .26*, .20, .19, .19, .19

[Heated to a bright yellow and quenched in water.]

Flat	1½×½.....	1.50×.258	.387	20,740	53,590	.....	18.9	1.34×.23=.308.....	20.4	Fibrous; small granular spots.	.15, .14, .19, .19, .24, .29*, .20, .17, .16, .16
Do[a]...	2×½.....	2.00×.257	.514	26,700	51,950	.....	14.2	1.77×.22=.389.....	24.3	Fibrous.....	.13, .12, .14, .14, .15, .14, .14, .15, .15, .16
Do....	2½×½.....	2.53×.255	.645	38,600	59,850	.....	9.6	2.40×.23=.552.....	14.4	Fibrous; granular streak.	.08, .12, .11, .08, .11, .11, .10, .07, .10, .08
Do....	1×½.....	1.03×.499	.514	25,910	50,410	.....	19.4	.84×.39=.328.....	36.2	Fibrous; granular spots.	.07, .09, .13, .28, .45*, .19, .10, .15, .19, .19
Do....	1½×½.....	1.55×.499	.773	41,400	53,560	.....	18.2	1.26×.38=.479.....	38.1	Fibrous.....	.12, .13, .14, .15, .30, .45*, .14, .14, .12, .13
Do....	.....do	1.55×.499	.773	35,600	46,050	.....	11.1	1.51×.43=.649.....	16.0	Fibrous; cinder spot at edge.	.12, .29*, .08, .10, .10, .09, .09, .08, .08, .08
Do....	2×½.....	2.03×.494	1.003	55,280	55,120	.....	16.0	1.69×.42=.710.....	29.2	Fibrous; small granular spots.	.13, .14, .15, .15, .14, .16, .17, .18, .19, .18
Do....	2½×½.....	2.50×.500	1.250	63,400	50,720	.....	12.6	2.31×.44=1.016.....	18.7	.....do	.11, .10, .11, .11, .11, .10, .15, .23*, .13, .11
Do....	1×⅝.....	1.01×.740	.747	47,300	63,320	.....	16.4	.87×.64=.557.....	25.5	.....do	.13, .11, .13, .15, .16, .15, .15, .14, .19, .33*
Do....	1½×⅝.....	1.49×.744	1.109	55,200	49,780	.....	11.7	1.37×.64=.877.....	20.9	Fibrous; granular center.	.08, .09, .10, .12, .11, .12, .13, .13, .14, .15
Do....	2×⅝.....	1.99×.766	1.524	79,900	52,430	.....	11.2	1.88×.69=1.297.....	14.9	Fibrous; granular spots.	.10, .10, .10, .10, .09, .10, .11, .12, .10, .20*
Do....	2½×⅝.....	2.57×.747	1.920	{Above 99,000	Above 51,560	} Above the capacity of the 100,000 pounds testing machine. Bar annealed, and again tested, as follows:					
Do....	.....do	2.47×.714	1.764	85,500	48,470	.....	27.6	2.17×.59=1.280.....	27.4	Fibrous; granular spots.	.27, .22, .22, .25, .24, .25, .26, .23, .28, .54*

[a] These specimens reached a scintillating heat.

TENSILE TESTS OF WROUGHT IRON.—Continued.

BURDEN'S BEST IRON.

[Heated to a bright yellow and cooled in air.]

Shape.	Nominal size.	Actual dimensions.	Sectional area.	Tensile strength. Total.	Per square inch.	Mean.	Elongation in 10 inches	Area at fracture.	Contraction of area.	Appearance of fracture.	Elongation of inch sections.
	Inch.	*Inch.*	*Sq. inch.*	*Pounds*	*Pounds*	*Pounds*	*Per cent.*	*Inch. Sq. inch.*	*Per cent.*		" " " " " " " " " "
Round..	½ diameter..	.501 diameter.	.197	9,200	46,700	.....	24.5	.35 diameter=.096 .	51.3	Fibrous.....	.20, .20, .22, .22, .35, .45*, .22, .19, .20, .20
Flat	2½×¼.....	2.47×.242	.598	27,900	46,660	.....	23.2	2.06×.19=.391.....	34.6	....do	.19, .19, .18, .17, .20, .22, .23, .23, .39*, .22
Do....	2½×½.....	2.50×.506	1.265	57,580	45,480	.....	27.1	2.00×.37=.740.....	41.5	Fibrous; granular spots.	.21, .20, .19, .21, .21, .22, .21, .29, .62*, .35
Do....	1×¾.....	1.02×.755	.770	36,190	47,000	.....	27.2	.72×.55=.396.....	48.6	.....do	.22, .19, .21, .21, .23, .20, .24, .28, .64*, .30

[Heated to a bright yellow and quenched in oil.]

Flat	1×¼.....	1.05×.245	.257	13,860	53,930	.....	19.4	.88×.19=.167.....	35.0	Fibrous.....	.14, .18, .16, .14, .16, .22, .37*, .18, .19, .20
Do....	1×½.....	1.08×.501	.516	24,580	47,540	.....	25.7	.83×.38=.315.....	39.0	Fibrous; granular spots.	.22, .22, .22, .23, .23, .23, .23, .32, .41*, .26
Do....	2×¾.....	2.02×.746	1.507	80,800	53,620	.....	18.6	1.61×.56=.902.....	40.1	.....do	.15, .16, .17, .17, .17, .17, .18, .20, .22, .27

[Heated to a bright yellow and quenched in water.]

Round..	½ diameter..	.500 diameter.	.196	10,400	53,020	.....	18.2	.33 diameter=.086 .	56.1	Fibrous.....	.21, .20, .16, .16, .17, .17, .18, .19, .19, .19
Flat	1×¼.....	1.05×.242	.254	13,900	54,720	.....	11.8	.96×.22=.211.....	16.9	.....do	.11, .11, .10, .10, .11, .12, .09, .19*, .12, .13
Do....	2½×½.....	2.47×.240	.593	31,100	52,440	.....	17.4	2.11×.19=.401.....	32.4	Fibrous; broke in jaw.	.13, .14, .15, .11, .18, .21, .22, .19, .21, .20
Do....	1×½.....	1.02×.498	.508	24,550	48,330	.....	19.9	.81×.38=.308.....	39.4	Fibrous; small granular spots.	.18, .17, .16, .18, .21, .21, .22, .23, .21, .22
Do....	2½×½.....	2.49×.504	1.255	71,170	56,710	.....	20.8	2.00×.38=.760.....	39.4	Fibrous; granular spots.	.15, .14, .14, .16, .18, .19, .57*, .23, .17, .15
Do....	1×¾.....	1.01×.757	.765	42,220	55,190	.....	21.0	.75×.58=.435.....	43.1	.....do	.18, .17, .17, .17, .18, .18, .17, .16, .18, .54*
Do....	2×¾.....	2.02×.747	1.509	89,900	59,580	.....	20.8	1.67×.58=.969.....	35.8	.....do	.16, .16, .15, .16, .18, .26, .49*, .18, .17, .17

NORWAY IRON.

[Heated to a bright yellow and cooled in air.]

Flat	2 × ½	2.02×.496	1.002	42,000	41,920		36.5	1.89×.31=.431	57.0	Fibrous	.26,	.34,	.33,	.30,	.32,	.36,	.84*,	.37,	.27,	.26
Do	2½ × ½	2.52×.493	1.242	54,000	43,480		18.0	2.00×.31=.620	49.9	do	,17,	.17,	.18,	.18,	.15,	.15,	.14,	.15,	.22,	.69
Do	1 × ¾	1.02×.741	.756	31,630	41,840		33.2	.63×.45=.284	62.4	do	.21,	.22,	.24,	.33,	.30,	.41,	.72*,	.34,	.27,	.28
Do	1½ × ¾	1.52×.782	1.113	44,870	40,310		38.3	.89×.41=.365	67.2	do	.27,	.27,	.30,	.32,	.33,	.38,	.90*,	.43,	.36,	.27
Do	2 × ¾	2.01×.748	1.503	62,500	41,580		21.6	1.49×.53=.790	47.4	do	.23,	.19,	.21,	.23,	.21,	.25,	.27,	.38,	.85*,	.36
Do	2½ × ¾	2.56×.755	1.983	79,900	41,330		32.1	1.84×.53=.975	49.6	do	.23,	.19,	.21,	.23,	.24,	.25,	.27,	.38,	.85*,	.36

[Heated to a bright yellow, and quenched in oil.]

Round	1 diameter	1.003 diameter	.790	38,400	48,610		21.0	.60 diameter=.283	64.2	Fibrous	.07,	.17,	.12,	.15,	.31,	.66*,	.19,	.15,	.13,	.15
Flat	1 × ½	1.01×.495	.500	21,600	43,200		25.3	.68×.27=.184	63.2	Fibrous; broke in jaw.	.27,	.28,	.29,	.26,	.26,	.24,	.22,	.26,	.27,	.18
Do	2 × ½	2.01×.499	1.003	46,980	46,840		29.6	1.54×.31=.477	52.4	Fibrous	.23,	.22,	.25,	.31,	.87*,	.21,	.25,	.22,	.20,	.20
Do	2½ × ½	2.52×.495	1.222	51,300	41,980		8.5	2.26×.40=.904	26.0	Fibrous; large granular spots.	.07,	.07,	.07,	.07,	.08,	.12,	.10,	.10,	.09,	.08
Do	1 × ¾	1.02×.745	.760	34,760	45,740		18.7	.63×.46=.290	61.8	Fibrous	.16,	.17,	.19,	.17,	.19,	.18,	.18,	.19,	.21,	.23
Do	1½ × ¾	1.51×.731	1.104	47,640	43,150		34.7	1.01×.46=.465	57.6	do	.22,	.23,	.24,	.26,	.28,	.28,	.33,	.41,	.84*,	.38
Do	2 × ¾	2.01×.749	1.505	71,200	47,310		21.0	1.55×.52=.806	46.4	do	.18,	.18,	.21,	.27,	.31,	.22,	.20,	.18,	.17,	.18
Do	2½ × ¾	2.54×.734	1.864	84,700	45,440		28.2	1.72×.48=.826	55.7	do	.19,	.16,	.15,	.19,	.16,	.19,	.22,	.31,	.64*,	.61*

[Heated to a bright yellow and quenched in water.]

Round	1 diameter	1.002 diameter	.789	36,800	46,640		27.4	.56 diameter=.246	68.8	Fibrous	.15,	.14,	.16,	.17,	.22,	.24,	.27,	.48*,	.67,	.24
Flat	1 × ½	1.02×.497	.507	23,000	45,360		20.4	.71×.27=.192	62.1	Fibrous; broke in jaw.	.19,	.16,	.25,	.22,	.17,	.22,	.20,	.20,	.22,	.21
Do	2 × ½	2.02×.498	1.006	48,400	48,110		16.4	1.46×.30=.438	56.8	do	.16,	.17,	.17,	.19,	.16,	.18,	.16,	.16,	.14,	.15
Do[a]	2½ × ½	2.50×.490	1.225	54,400	44,410		8.0	2.30×.40=.920	24.9	Fibrous; large granular spots.	.04,	.04,	.05,	.03,	.06,	.05,	.06,	.18,	.23*,	.06
Do	1 × ¾	1.01×.745	.752	37,710	50,150		15.0	.65×.47=.306	59.3	Fibrous; granular spot.	.14,	.14,	.15,	.16,	.15,	.16,	.16,	.18,	.11,	.15
Do	1½ × ¾	1.50×.725	1.088	48,700	44,760		21.4	.97×.44=.427	60.8	Fibrous	.20,	.21,	.21,	.22,	.21,	.19,	.19,	.20,	.23,	.28
Do	2 × ¾	1.99×.748	1.489	72,400	48,620		26.9	1.39×.47=.653	56.1	do	.14,	.13,	.14,	.18,	.20,	.23,	.27,	.36,	.83,	.21
Do	2½ × ¾	2.54×.753	1.913	89,500	46,790		15.3	1.87×.54=1.010	47.2	do	.15,	.13,	.13,	.14,	.09,	.15,	.16,	.17,	.19,	.20

[a] Snapping sounds heard above 45,000 pounds. A granular streak of metal in the bar broke before the rest.

Second Series.

Strength and Elongation of Wrought Iron Bars after Treatment by Heating to a Full Yellow Heat and Cooling in Air, Water, and Oil.

Finished bars were treated and threaded ends subsequently cleaned in the lathe; stems of specimens not redressed.

Specimens of this series were turned down from 1¼″ rolled rods.

No. 7474.

Common Refined Iron.
Heated full yellow and cooled in air.
Diameter, ″.794.
Sectional area, .50 square inch.
Length of stem, 7″.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0021	0.	
15,000	.0031	0.	
20,000	.0043	0.	
25,000	.0055	.0001	
30,000	.0069	.0003	
31,000	.0072	.....	
32,000	.0076	.....	
33,000	.0079	.....	
34,000	.0082	.....	Elastic limit.
32,000	.0263	.....	
33,000	.0380	.....	
34,000	.1015	.....	
35,000	.1100	.....	
36,000	.1320	.....	
37,000	.1465	.....	
38,000	.1650	.....	
40,000	.22	.....	
42,000	.27	.....	
44,000	.34	.....	
46,000	.43	.....	
48,000	.53	.....	
50,000	.69	.....	
52,000	1.07	.....	
52,440	1.36	.....	Tensile strength.
0	1.58	.....	=26.3 per cent.

Elongation of inch sections, ″.19, ″.21, ″.23, ″.49*, ″.25, ″.21.
Diameter at fracture, ″.59; area, .2734 square inch.
Contraction of area, 45.3 per cent.
Appearance of fracture, fibrous.

No. 7475.

Common Refined Iron.
Heated full yellow and quenched in oil.
Diameter, ".795.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	0.	
10,000	.0020	0.	
15,000	.0031	0.	
20,000	.0041	0.	
25,000	.0054	.0001	
30,000	.0071	.0009	Elastic limit.
31,000	.0078	.....	
32,000	.0084	.....	
33,000	.0092	.....	
34,000	.0108	.....	
35,000	.0130	.0059	
36,000	.0180	.....	
37,000	.0360	.....	
38,000	.0560	.....	
39,000	.0725	.....	
40,000	.0860	.0763	
41,000	.0970	.....	
42,000	.1185	.....	
43,000	.1420	.....	
44,000	.1610	.....	
46,000	.20	.....	
48,000	.27	.....	
50,000	.34	.....	
52,000	.42	.....	
54,000	.53	.....	
56,000	.74	.....	
56,400	.....	.....	Tensile strength.
0	.91	.....	=15.2 per cent.

Elongation of inch sections, ".12, ".09, ".12, ".12, ".15, ".31*.
Diameter at fracture, ".67; area, .3526 square inch.
Contraction of area, 29.5 per cent.
Appearance of fracture, fibrous.

No. 7476.

Common Refined Iron.
Heated full yellow and quenched in water.
Diameter, ".796.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0011	0.	
10,000	.0023	.0001	
15,000	.0039	.0002	
20,000	.0052	.0008	
25,000	.0073	.0015	
26,000	.0078	.....	
27,000	.0082	.....	
28,000	.0088	.....	
29,000	.0093	.....	
30,000	.0101	.0032	
31,000	.0109	.....	
32,000	.0118	.....	
33,000	.0126	.....	
34,000	.0143	.....	
35,000	.0164	.0086	
36,000	.0197	.....	
38,000	.0340	.....	
40,000	.0510	.0413	
42,000	.0680	.....	
44,000	.1010	.....	
46,000	.1360	.....	
48,000	.1770	.....	
50,000	.23	.....	
52,000	.29	.....	
54,000	.36	.....	
56,000	.46	.....	
58,000	.60	.....	
60,000	.83	.....	
60,400	.....	.....	Tensile strength.
0	1.00	.....	=16.7 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".32*, ".13, ".13, ".13, ".14, ".15.
Diameter at fracture, ".60; area, .2827 square inch.
Contraction of area, 43.5 per cent.
Appearance of fracture, fibrous.

No. 7477.

Best Puddled Iron.
Heated full yellow and cooled in air.
Diameter, ".795.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0011	.0001	
10,000	.0024	.0001	
15,000	.0037	.0002	
20,000	.0049	.0002	
25,000	.0060	.0008	
30,000	.0076	.0009	
31,000	.0080	.....	Elastic limit.
32,000	.0340	.....	
31,000	.0660	.....	
32,000	.0700	.....	
33,000	.0850	.....	
34,000	.1000	.....	
35,000	.1180	.1095	
36,000	.1320	.....	
37,000	.1580	.....	
38,000	.1770	.....	
40,000	.24	.....	
42,000	.29	.....	
44,000	.37	.....	
46,000	.46	.....	
48,000	.58	.....	
50,000	.77	.....	
51,600	.....	.....	Tensile strength.
0	1.51	.....	= 25.2 per cent.

Elongation of inch sections, ".19, ".19, ".22, ".38*, "29. ".24.
Diameter at fracture, ".64; area, .3217 square inch.
Contraction of area, 35.7 per cent.
Appearance of fracture, fibrous.

No. 7478.

Best Puddled Iron.
Heated full yellow and quenched in oil.
Diameter, ".797.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	0.	
10,000	.0019	0.	
15,000	.0030	0.	
20,000	.0041	0.	
25,000	.0054	.0001	
28,000	.0069	.....	
29,000	.0074	.....	Elastic limit.
30,000	.0090	.0024	
31,000	.0100	.....	
32,000	.0120	.....	
33,000	.0160	.....	
34,000	.0230	.....	
35,000	.0400	.0320	
36,000	.0620	.....	
38,000	.0880	.....	
40,000	.1190	.1094	
42,000	.1500	.....	
44,000	.21	.....	
46,000	.28	.....	
48,000	.34	.....	
50,000	.43	.....	
52,000	.55	.....	
54,000	.74	.....	
55,760	.....	.....	Tensile strength.
0	1.44	.....	=24 per cent.

Elongation of inch sections, ".20, ".22, ".21, ".27, ".33*, ".21.
Diameter at fracture, ".64; area, .3217 square inch.
Contraction of area, 35.7 per cent.
Appearance of fracture, fibrous.

No. 7479.

Best Puddled Iron.
Heated full yellow and quenched in water.
Diameter, ″.797.
Sectional area, .50 square inch.
Length of stem, 7″.
Gauged length, 6″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	0.	
10,000	.0020	0.	
15,000	.0034	.0004	
16,000	.0038	.....	
17,000	.0041	.....	
18,000	.0043	.....	
19,000	.0048	.....	
20,000	.0051	.0010	
21,000	.0057	.....	
22,000	.0060	.....	
23,000	.0064	.....	
24,000	.0069	.....	
25,000	.0077	.0022	
26,000	.0081	.....	
27,000	.0087	.....	
28,000	.0093	.....	
29,000	.0102	.....	
30,000	.0112	.0050	
32,000	.0142	.....	
34,000	.0196	.....	
36,000	.0300	.....	
38,000	.0530	.....	
40,000	.0780	.0685	
42,000	.1015	.....	
44,000	.1400	.....	
46,000	.17	.....	
48,000	.24	.....	
50,000	.30	.....	
52,000	.38	.....	
54,000	.48	.....	
56,000	.65	.....	
57,120	.82	.....	Tensile strength.
0	.85	.....	= 14.2 per cent.

Elastic limit indefinite.
Elongation of inch sections, ″.19, ″.13, ″.15, ″.14, ″.12, ″.12.
Diameter at fracture, ″.67; area, .3526 square inch.
Contraction of area, 29.5 per cent.
Appearance of fracture, fibrous, trace of granulation. Fractured outside the 6-inch gauged length.

No. 7480.

Burden's Best Iron.
Heated full yellow and cooled in air.
Diameter, ".797.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0020	0.	
15,000	.0031	0.	
20,000	.0042	0.	
25,000	.0053	0.	
30,000	.0063	0.	
34,000	.0071	.....	
35,000	.0078	.....	Elastic limit.
31,000	.0180	.....	
30,000	.0280	.....	
31,000	.0850	.....	
32,000	.1260	.....	
33,000	.1540	.....	
34,000	.1650	.1567	
36,000	.21	.....	
38,000	.25	.....	
40,000	.30	.....	
42,000	.37	.....	
44,000	.45	.....	
46,000	.57	.....	
48,000	.75	.....	
50,000	1.14	.....	
50,120	.....	.....	Tensile strength.
0	1.72	.....	= 28.7 per cent.

Elongation of inch sections, ".19, ".23, ".46*, ".43*, ".21, ".20.
Diameter at fracture, ".55; area, .2376 square inch.
Contraction of area, 52.5 per cent.
Appearance of fracture, fine fibrous.

No. 7481.

Burden's Best Iron.
Heated full yellow and quenched in oil.
Diameter, ".795.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0017	0.	
15,000	.0026	0.	
20,000	.0036	0.	
25,000	.0049	0.	
30,000	.0061	0.	
35,000	.0076	.0003	Elastic limit.
36,000	.0081	.....	
37,000	.0088	.....	
38,000	.0104	.....	
39,000	.0150	.....	
40,000	.0518	.0424	
41,000	.0680	.....	
42,000	.0810	.....	
43,000	.0925	.....	
44,000	.1090	.....	
45,000	.1200	.1088	
46,000	.14	.....	
48,000	.18	.....	
50,000	.22	.....	
52,000	.26	.....	
54,000	.31	.....	
56,000	.39	.....	
58,000	.48	.....	
60,000	.67	.....	
61,360	.96	.....	Tensile strength.
0	1.20	.....	= 20 per cent.

Elongation of inch sections: ".17, ".13, ".11, ".14, ".19, ".46*.
Diameter at fracture, ".57; area, .2552 square inch.
Contraction of area, 49 per cent.
Appearance of fracture, fine fibrous.

No. 7482.

Burden's Best Iron.
Heated full yellow and quenched in water.
Diameter, ".796.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0009	0.	
10,000	.0021	0.	
15,000	.0035	.0001	
20,000	.0048	.0001	
25,000	.0062	.0008	
26,000	.0066	.....	
27,000	.0070	.....	
28,000	.0072	.....	
29,000	.0077	.....	
30,000	.0080	.0014	
31,000	.0085	.....	
32,000	.0090	.....	
33,000	.0093	.....	
34,000	.0100	.....	
35,000	.0106	.0030	
36,000	.0114	.....	
37,000	.0122	.....	
38,000	.0132	.....	
39,000	.0150	.....	
40,000	.0172	.0088	
41,000	.0190	.....	
42,000	.0220	.....	
43,000	.0261	.....	
44,000	.0418	.....	
45,000	.0473	.0370	
46,000	.0550	.....	
47,000	.0642	.....	
48,000	.0740	.....	
49,000	.0849	.....	
50,000	.0980	.0860	
51,000	.1023	.....	
52,000	.1283	.....	
53,000	.1358	.....	
54,000	.1590	.....	
55,000	.1780	.1637	
56,000	.19	.....	
57,000	.22	.....	
58,000	.25	.....	
60,000	.30	.....	
62,000	.37	.....	
64,000	.45	.....	
65,000	.51	.....	
66,000	.62	.....	
66,280	.70	.....	Tensile strength.
0	.95	.....	=16.8 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".10, ".17, ".42*, ".10, ".08, .08".
Diameter at fracture, ".57; area, .2552 square inch.
Contraction of area, 49 per cent.
Appearance of fracture, fine fibrous.

No. 7483.

Norway Iron.
Heated full yellow and cooled in the air.
Diameter, ".792.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0018	0.	
15,000	.0028	0.	
18,000	.0033	.....	
19,000	.0036	.....	
20,000	.0040	.0002	Elastic limit.
21,000	.0170	.....	
20,000	.0270	.....	
21,000	.0600	.....	
22,000	.0785	.....	
23,000	.1360	.....	
24,000	.1511	.....	Sustained load 3 minutes.
25,000	.1513	.....	
26,000	.1521	.....	
27,000	.2080	.....	
28,000	.2330	.....	
29,000	.2550	.....	
30,000	.2900	.2825	
31,000	.30	.....	
32,000	.35	.....	
33,000	.39	.....	
34,000	.43	.....	
35,000	.48	.....	Rested 5 minutes under load of 1,000 pounds per square inch.
36,000	.48+	.....	
37,000	.58	.....	
38,000	.65	.....	
39,000	.73	.....	
40,000	.88	.....	
41,000	1.00	.....	
42,000	1.28	.....	
42,400	.....	.....	Tensile strength.
0	2.22	.....	= 37 per cent.

Elongation of inch sections, ".31, ".79*, ".36, ".27, ".25, ".24.
Minimum diameter, ".41; area, .1320 square inch.
Contraction of area, 73.6 per cent.
Bar not fractured. Test discontinued before rupture. Load on bar when test was discontinued, 13,000 pounds total=98,480 pounds per square inch.

No. 7484.

Norway Iron.
Heated full yellow and quenched in oil.
Diameter, ".797.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0010	0.	
10,000	.0021	0.	
15,000	.0031	0.	
18,000	.0039	.....	
19,000	.0042	.....	Elastic limit.
20,000	.0050	.....	
	.0083	.0040	
21,000	.0179	.....	
22,000	.0585	.....	
23,000	.0775	.....	
24,000	.0900	.....	
25,000	.1070	.1013	
26,000	.1165	.....	
27,000	.1450	.1388	Rested 5 minutes under load of 1,000 pounds per square inch.
28,000	.1469	.....	
29,000	.1850	.....	
30,000	.2100	.2033	
31,000	.24	.....	
32,000	.27	.....	
33,000	.30	.....	
34,000	.34	.....	
36,000	.42	.....	
38,000	.50	.....	
40,000	.64	.....	
42,000	.83	.....	
43,000	1.00	.....	
44,000	1.27	.....	
44,240	1.70	.....	Tensile strength.
0	2.21	.....	= 36.8 per cent.

Elongation of inch sections, ".77*, ".35, ".26, ".27, ".29, ".27.
Diameter at fracture, ".39; area, .1195 square inch.
Contraction of area, 76.1 per cent.
Appearance of fracture, fibrous.

No. 7485.

Norway Iron.
Heated full yellow and quenched in water.
Diameter, ".796.
Sectional area, .50 square inch.
Length of stem, 7".
Gauged length, 6".

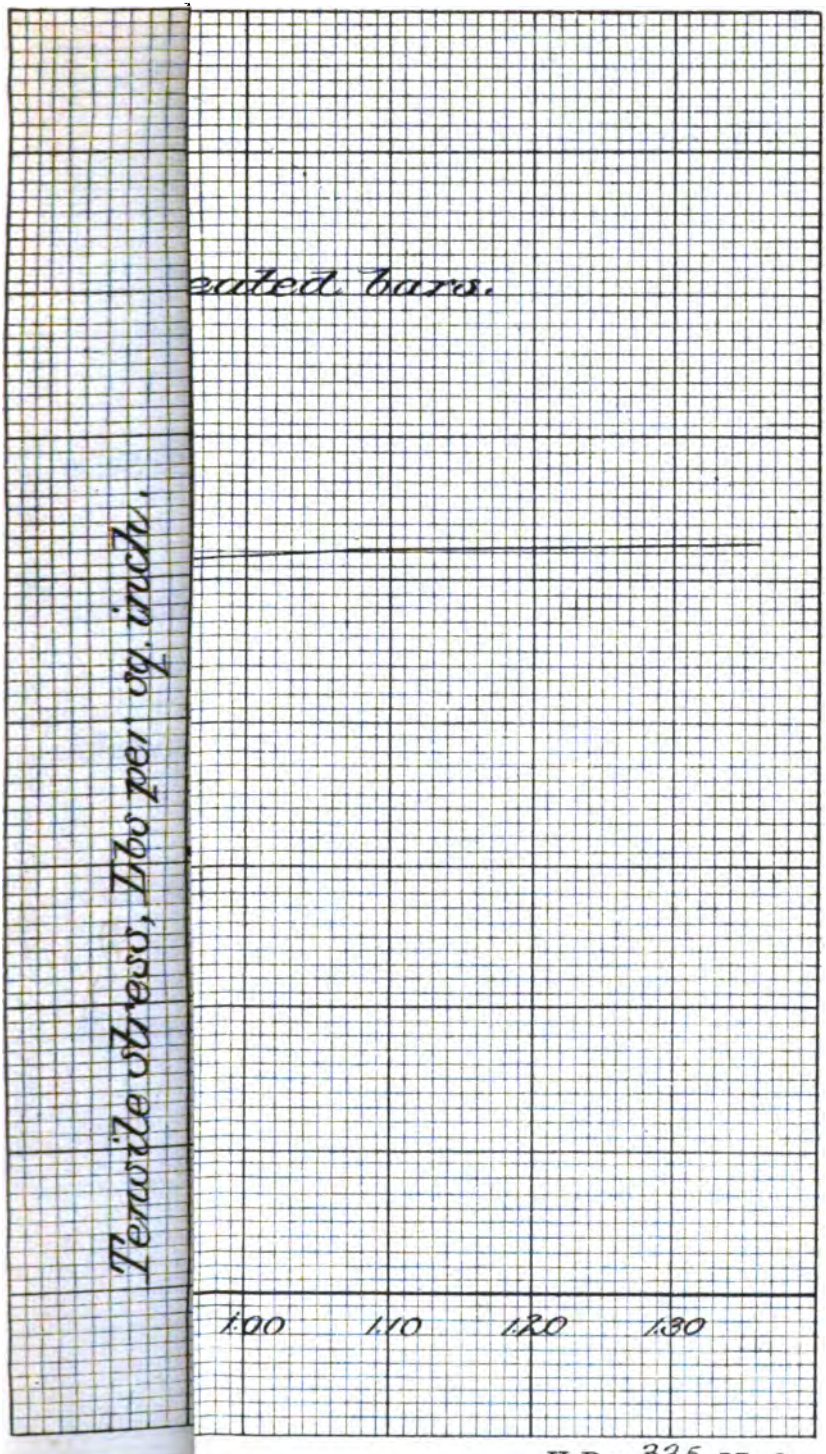
Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0016	0.	
15,000	.0029	.0002	
16,000	.0032	.....	
17,000	.0037	.....	
18,000	.0045	.....	
19,000	.0051	.....	
20,000	.0061	.0020	
21,000	.0075	.....	
22,000	.0108	.....	
23,000	.0170	.....	
24,000	.0435	.....	
25,000	.0640	.0583	Rested 5 minutes under load of 1,000 pounds per square inch.
26,000	.0648	.....	
27,000	.0880	.....	
28,000	.1090	.....	
29,000	.1158	.....	
30,000	.1480	.1362	
31,000	.1500	.....	
32,000	.1900	.....	
33,000	.21	.....	
34,000	.25	.....	
36,000	.31	.....	
38,000	.38	.....	
40,000	.47	.....	
42,000	.60	.....	
44,000	.76	.....	
46,000	1.19	.....	
46,300	.....	.....	Tensile strength.
0	2.12	.....	= 35.3 per cent.

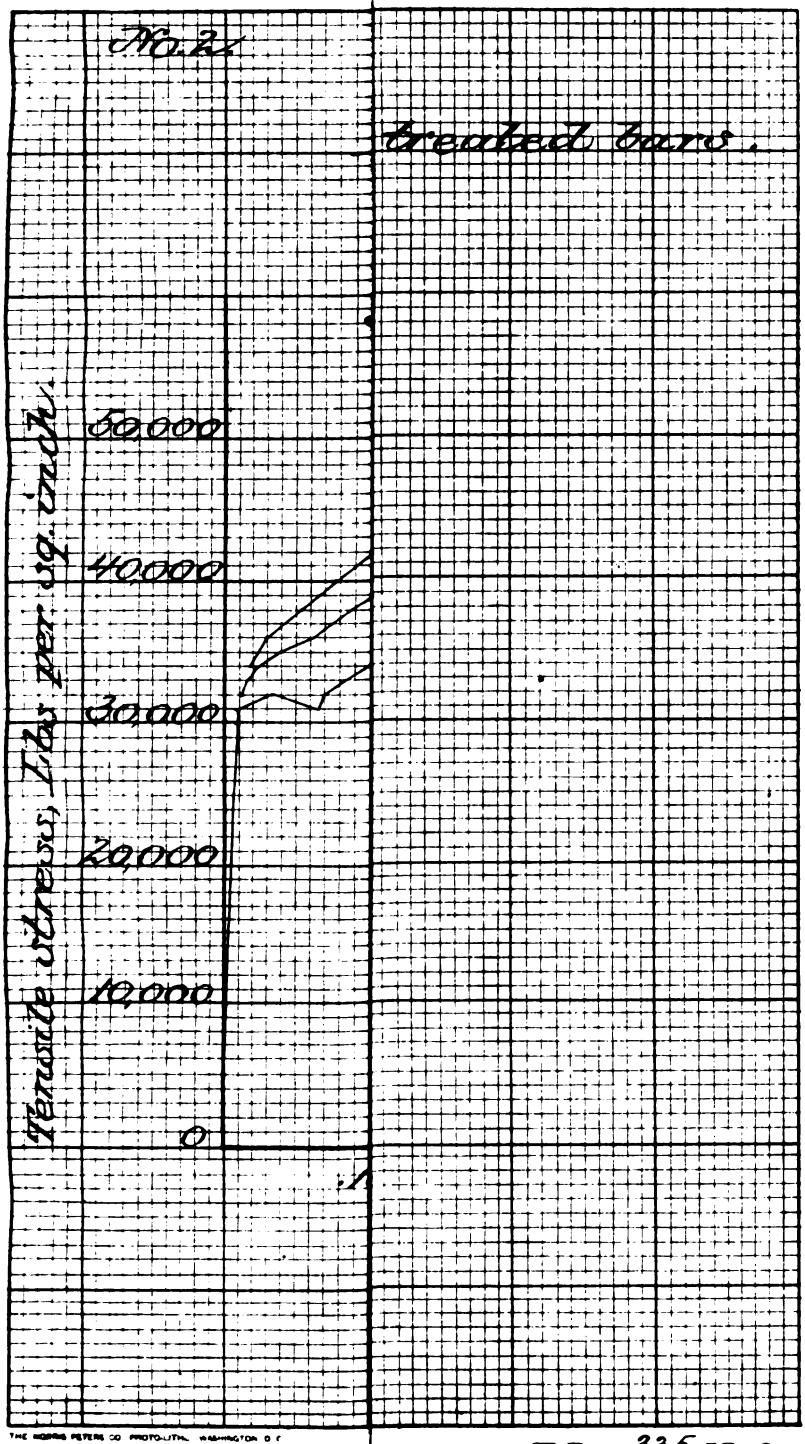
Elastic limit indefinite.
Elongation of inch sections, ".26, ".24, ".25, ".68*, ".43, ".26.
Diameter at fracture, ".39; area, .1195 square inch.
Contraction of area, 76.1 per cent.
Appearance of fracture, fibrous.

TABULATION OF TENSION TESTS ON WROUGHT IRON BARS AFTER TREATMENT.

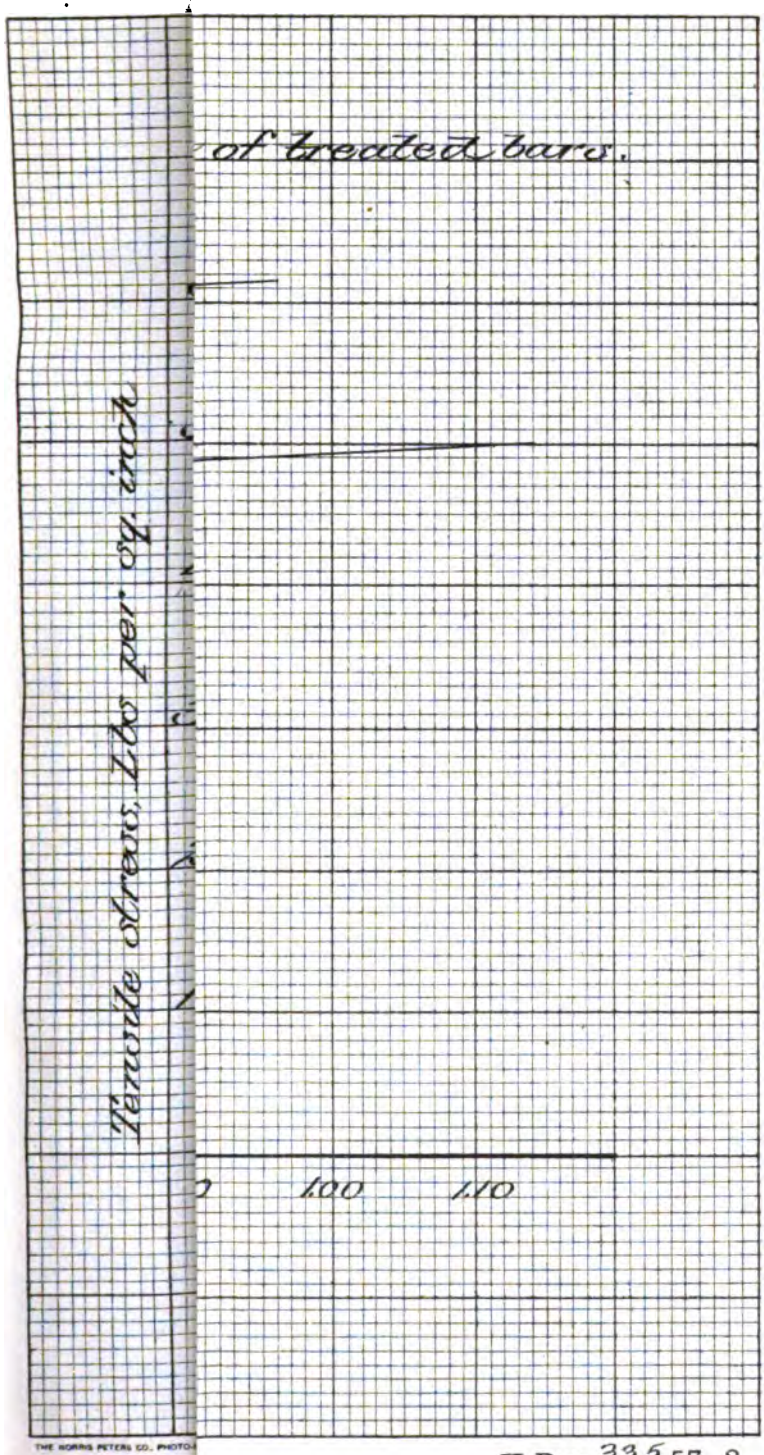
SECOND SERIES.

No. of test.	Kind of iron.	Treatment of specimen.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 6 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Sq. in.	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	" " " " " "	
7474	Common refined..	Heated full yellow and cooled in air.....	.50	34,000	52,440	26.3	45.8	.19, .21, .28, .49*, .25, .21	Fibrous.
7475	.....do	Heated full yellow and quenched in oil	.50	30,000	56,400	15.2	29.5	.12, .09, .12, .12, .15, .31*	Do.
7476	.....do	Heated full yellow and quenched in water.....	.50	.....	60,400	16.7	43.5	.32*, .13, .13, .13, .14, .15	Do.
7477	Best puddled	Heated full yellow and cooled in air.....	.50	31,000	51,600	25.2	35.7	.19, .19, .22, .38*, .29, .24	Do.
7478	.....do	Heated full yellow and quenched in oil	.50	29,000	55,760	24.0	35.7	.20, .22, .21, .27, .38*, .21	Do.
7479	.....do	Heated full yellow and quenched in water.....	.50	.....	57,120	14.2	29.5	.19, .13, .15, .14, .12, .12	Fibrous; trace of granulation.
7480	Burden's best	Heated full yellow and cooled in air.....	.50	35,000	50,120	28.7	52.5	.19, .23, .46*, .43*, .21, .20	Fine fibrous.
7481	.....do	Heated full yellow and quenched in oil	.50	35,000	61,360	20.0	49.0	.17, .13, .11, .14, .19, .46*	Do.
7482	.....do	Heated full yellow and quenched in water.....	.50	.....	66,280	15.8	49.0	.10, .17, .42*, .10, .08, .08	Do.
7483	Norway	Heated full yellow and cooled in air.....	.50	20,000	42,400	37.0	73.6	.31, .79*, .36, .27, .25, .24	
7484	.....do	Heated full yellow and quenched in oil	.50	19,000	44,240	36.8	76.1	.77*, .35, .26, .27, .29, .27	Fibrous.
7485	.....do	Heated full yellow and quenched in water.....	.50	.....	46,300	35.3	76.1	.26, .24, .25, .68, .43*, .26	Do.

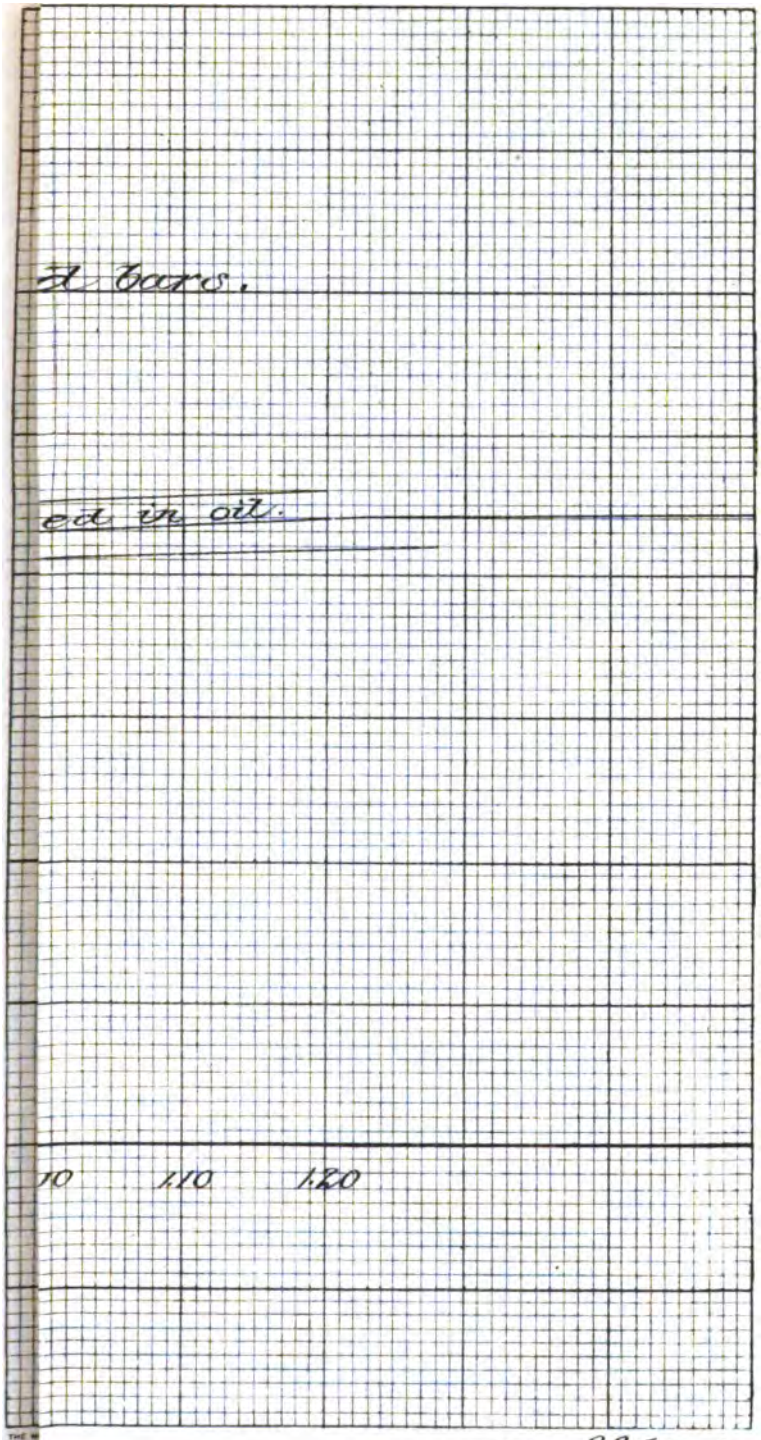

Tensile Stress, Lbs per sq. inch.
1.00
1.10
1.20
1.30



THE HOBBS PETERS CO PHOTO-LITH WASHINGTON D C



THE NORRIS PETERS CO., PHOTO


H bars.
ed in ott.
10
110
120

No. 7539.

Heated full yellow, quenched in oil, reheated and cooled in air.
Diameter, 1″.129.
Sectional area, 1 square inch.
Length of stem, 22″.
Gauged length, 20″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0030	0.	
10,000	.0067	0.	
15,000	.0104	0.	
20,000	.0140	0.	
21,000	.0148	.....	
22,000	.0156	.....	
23,000	.0165	.....	
24,000	.0173	.....	
25,000	.0181	.0004	
26,000	.0193	.....	
27,000	.0204	.....	Elastic limit. Not well defined.
28,000	.0218	.....	
29,000	.0234	.....	
30,000	.0266	.0050	
31,000	.0359	.....	
32,000	.0534	.....	
33,000	.0693	.....	
34,000	.0940	.....	
35,000	.1235	.0968	
36,000	.14	.....	
38,000	.20	.....	
40,000	.31	.....	
42,000	.44	.....	
44,000	.58	.....	
46,000	.77	.....	
48,000	.99	.....	
50,000	1.26	.....	
52,000	1.64	.....	
53,800	.....	.....	Tensile strength.
0	2.13	.....	= 10.7 per cent.

Elongation of inch sections, ″.12, ″.11, ″.10, ″.10, ″.09, ″.10, ″.10, ″.09, ″.09, ″.09, ″.10, ″.10, ″.10, ″.11, ″.12, ″.11, ″.12, ″.12, ″.13, ″.13.
Diameter at fracture, 1″.01; area, .8012 square inch.
Contraction of area, 19.9 per cent.
Fractured 1″.25 from the neck.
Appearance, fibrous 60 per cent, granular 40 per cent. Fractured outside the gauged length. Elongation ″.21 on the inch section which fractured.

ABULATION OF TENSION TESTS OF WROUGHT IRON BEFORE AND AFTER TREATMENT.

BEST PUDDLED IRON.

THIRD SERIES.

No. of test.	Treatment of bar.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 20 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
		Sq. in.	*Pounds.*	*Pounds.*	*Per cent.*	*Per cent.*	*Inch.*	
7534	Natural state	1.00	30,000	54,000	10.9	15.0	.10, .10, .10, .11, .10, .10, .11, .10, .10, .10, .11, .10, .12, .20*, .11, .10, .11, .10, .11, .10.	Fibrous, 80 per cent; granular, 20 per cent.
7535	Heated full yellow and cooled in air	1.00	29,000	51,800	9.4	16.7	.08, .08, .08, .08, .08, .09, .09, .08, .09, .09, .10, .08, .09, .09, .11, .11, .20*, .08, .10, .08.	Fibrous, 60 per cent; granular, 40 per cent.
7536	Heated full yellow and quenched in brine	1.00	26,000	54,000	6.6	10.1	.07, .07, .06, .07, .07, .07, .07, .06, .06, .07, .06, .07, .06, .06, .07, .06, .05, .05, 07, .11*.	Fibrous, 40 per cent; granular, 60 per cent.
7537	Heated full yellow and quenched in oil	1.00	25,000	48,100	4.2	10.1	.04, .03, .04, .03, .04, .04, .04, .03, .03, .03, .04, .04, .04, .04, .03, .04, .04, .03, .05, .14*.	Do.
7538	Heated full yellow, quenched in brine, reheated as before, and cooled in air.	1.00	25,000	53,100	9.9	16.7	.10, .08, .10, .09, .09, .10, .10, .09, .09, .09, .09, .09, .09, .09, .09, .10, .08, .10, .12, .21*.	Fibrous, 70 per cent; granular, 30 per cent.
7539	Heated full yellow, quenched in oil, reheated as before, and cooled in air.	1.00	27,000	53,800	10.7	19.9	.12, .11, .10, .10, .09, .10, .10, .09, .09, .09, .10, .10, .10, .11, .12, .11, .12, .12, .13, .13.	Fibrous, 60 per cent; granular, 40 per cent.

Elastic limits not well defined.

CARBON AND NICKEL STEEL INGOTS.

CARBON AND NICKEL STEEL INGOTS.

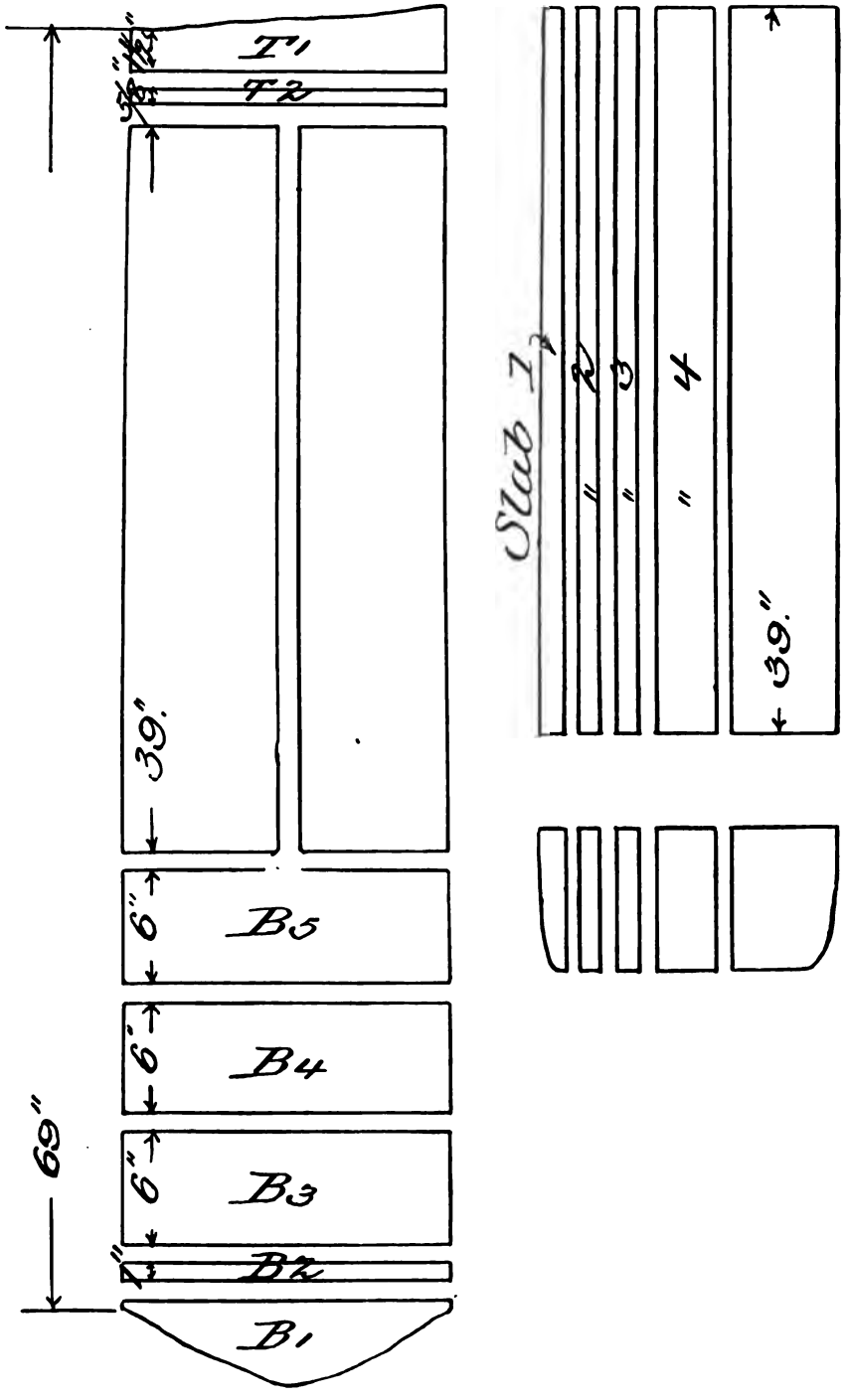
INGOTS CUT UP FOR EXAMINATION, AND MATERIAL FOR TENSILE AND ENDURANCE TESTS TAKEN THEREFROM.

CHEMICAL ANALYSES.

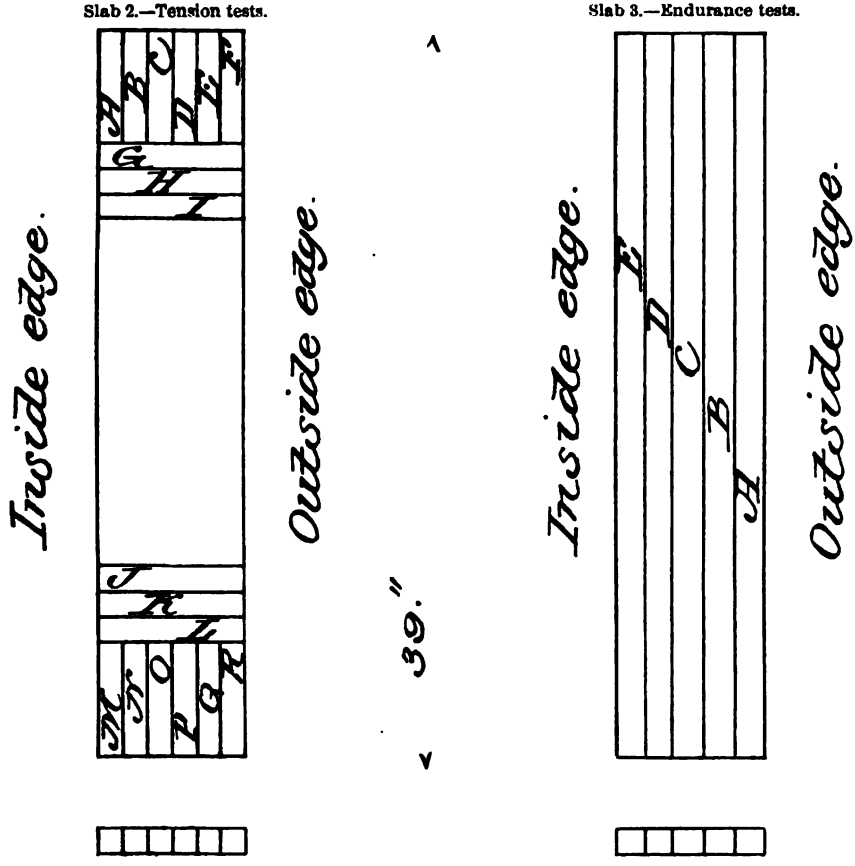
Carbon steel ingot:	
Carbon	.20
Manganese	.58
Silicon	.015
Phosphorus	.017
Nickel steel ingot:	
Carbon	.17
Manganese	.68
Silicon	.016
Phosphorus	.010
Nickel	3.25

No. 1.—16″ x 18″ Carbon Steel Ingot.

Showing manner of cutting up for examination.



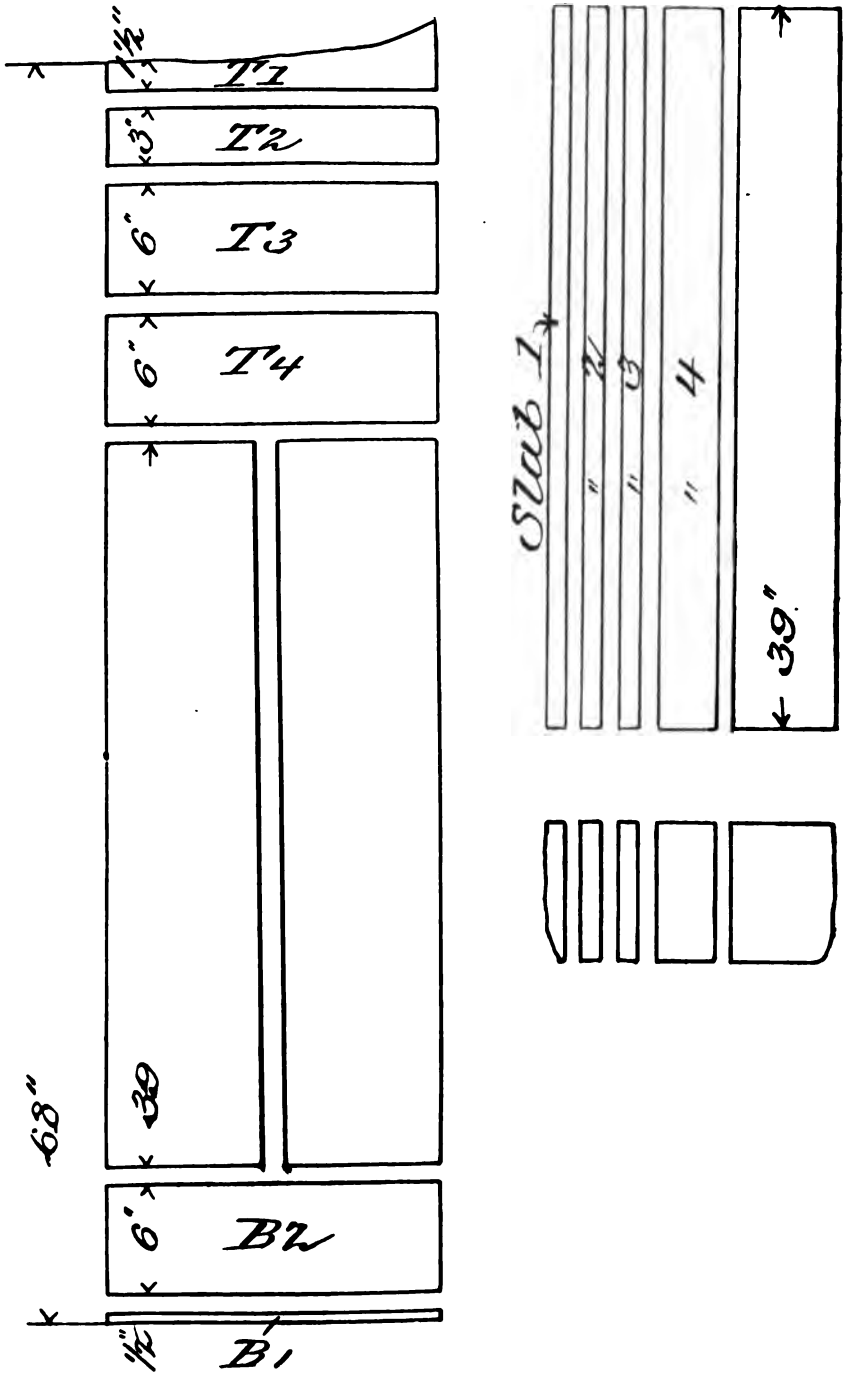
No. 2.—16″ x 18″ Carbon Steel Ingot.



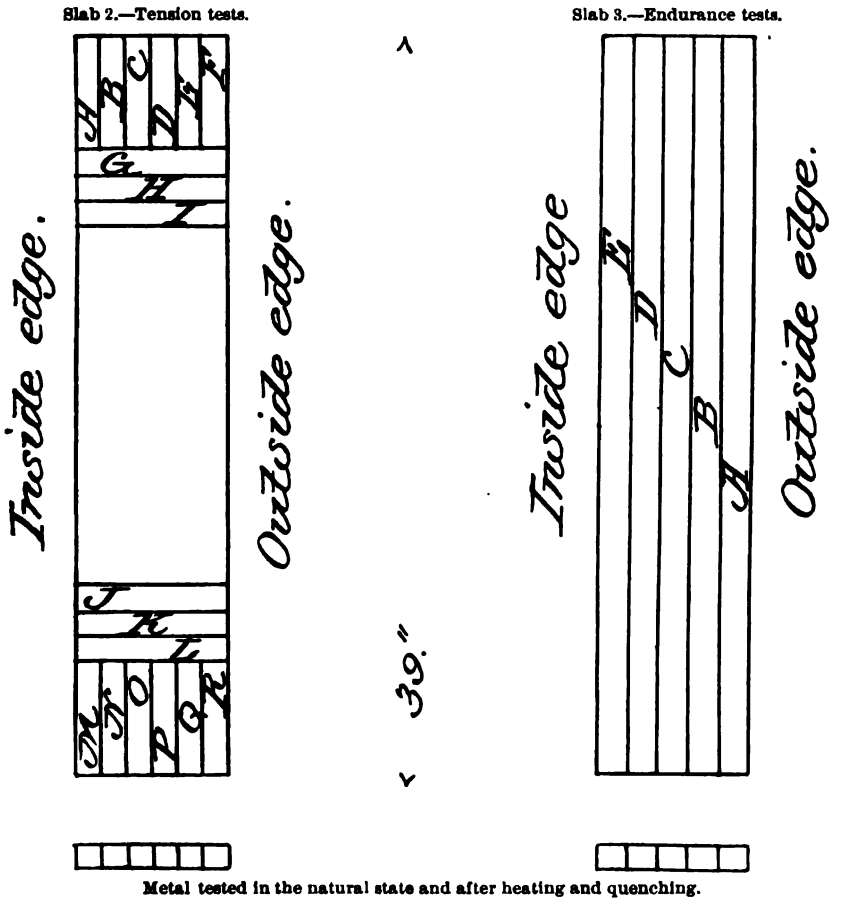
Metal tested in the natural state and after heating and quenching.

No. 3.—16″ x 18″ Nickel Steel Ingot.

Showing manner of cutting up for examination.



No. 4.—16″ x 18″ Nickel Steel Ingot.

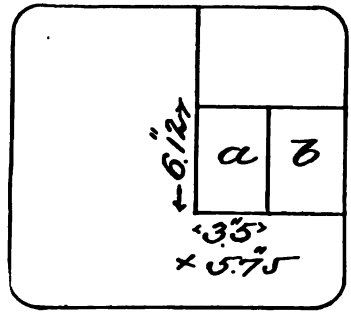


Metal tested in the natural state and after heating and quenching.

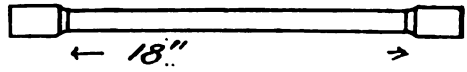
No. 5.—16″ x 18″ Steel Ingots.

Showing manner of cutting up for examination.

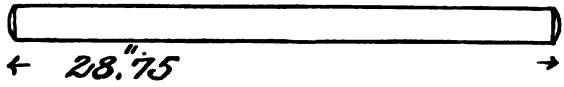
Carbon steel, block B 4.



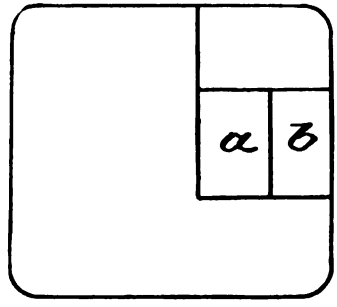
Tensile specimens (2) piece *a*.



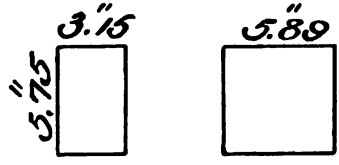
Bending specimen from *b*.



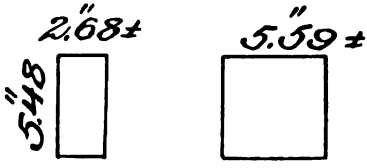
Nickel steel, block T 3.



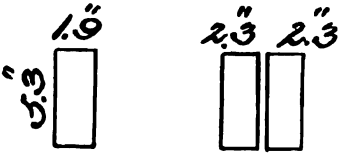
Piece *a* before forging.

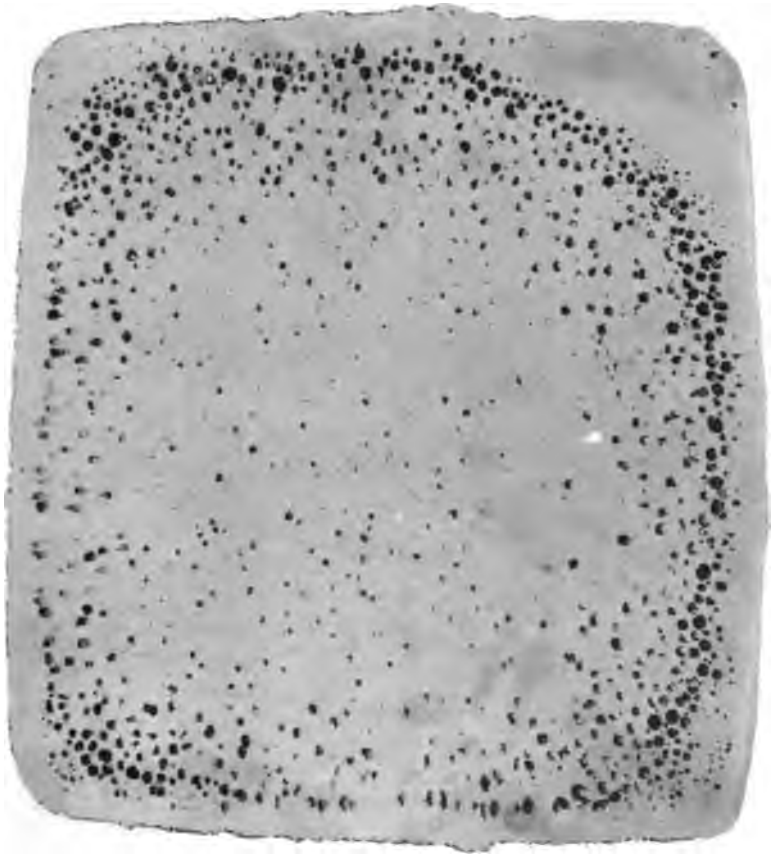


After forging.



After machining.

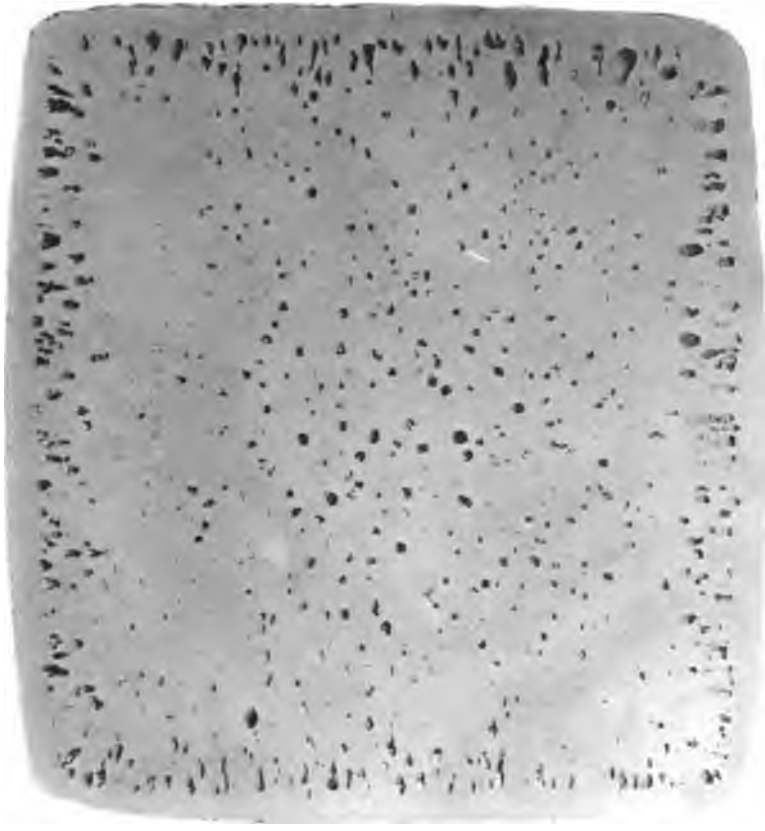




NO. 6.

CARBON STEEL INGOT

BLOCK 61 ½ INCH FROM THE BOTTOM.

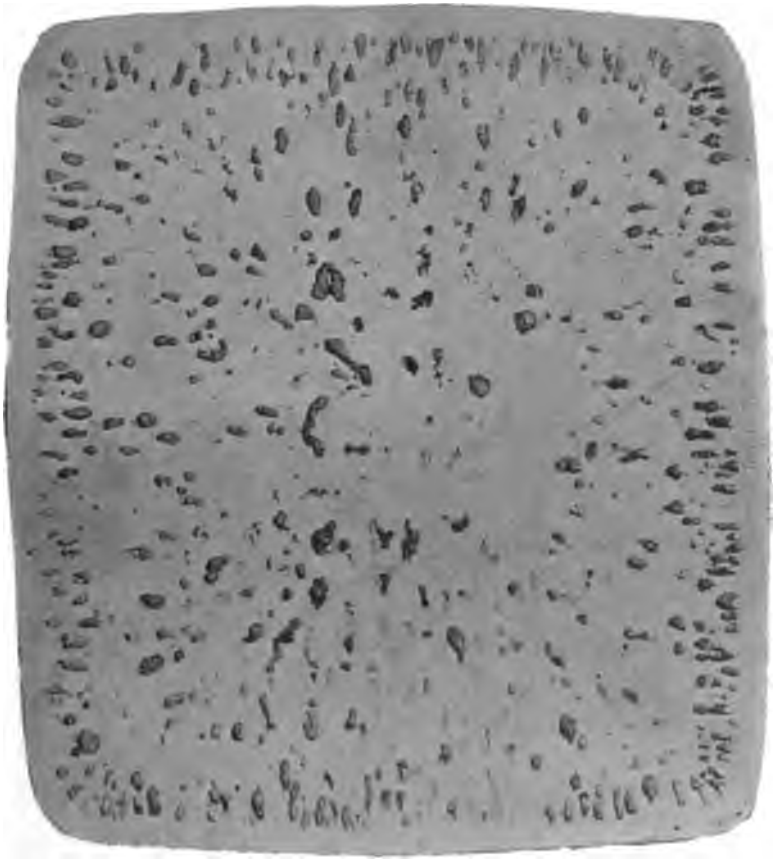


NO. 7.

CARBON STEEL INGOT.

BLOCK 52, 3½ INCHES FROM THE BOTTOM.

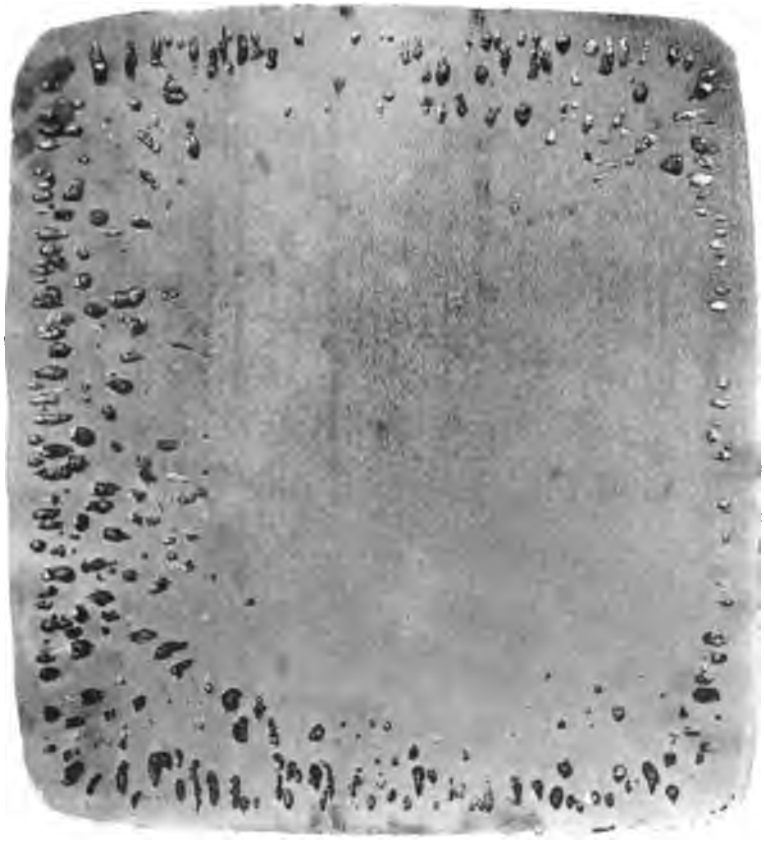
HELIOTYPE CO., BOSTON.



NO. 8.

CARBON STEEL INGOT, BLOCK B3. 9 1-2 INCHES FROM THE BOTTOM.

HELIOTYPE CO., BOSTON.



NO. 9.

CARBON STEEL INGOT, BLOCK B4. 16 1-2 INCHES FROM THE BOTTOM.

HELIOTYPE CO., BOSTON.

NO. 10.

CARBON STEEL INGOT, BLOCK B5. 23 1-2 INCHES FROM THE BOTTOM.

HEINTYPE CO., BOSTON

NO. 11.

CARBON STEEL INGOT.

LONGITUDINAL SECTION, MIDDLE OF LENGTH OF INGOT.

NO. 12.

CARBON STEEL INGOT.

BLOCK T2. 2 INCHES FROM THE TOP.

HELIOTYPE CO., BOSTON.

NO. 13.

NICKEL STEEL INGOT, BLOCK B1. 1-2 INCH FROM THE BOTTOM.

HELIOTYPE CO., BOSTON.

NO. 14.

NICKEL STEEL INGOT.

BLOCK 62. 7¼ INCHES FROM THE BOTTOM.

HELIOTYPE CO., BOSTON.

NO. 15.

NICKEL STEEL INGOT.

LONGITUDINAL SECTION, MIDDLE OF LENGTH OF INGOT.

NO. 16.

NICKEL STEEL INGOT.

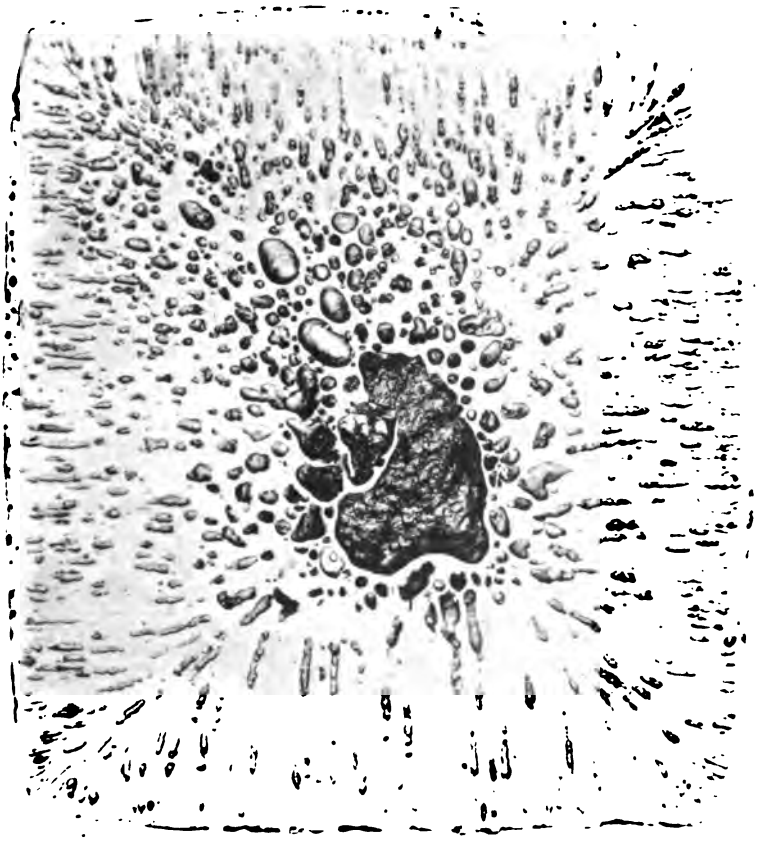
BLOCK T4. 18½ INCHES FROM THE TOP.

HELIOTYPE CO., BOSTON.

NO. 17.

NICKEL STEEL INGOT, BLOCK T3, 11 1-2 INCHES FROM THE TOP.

HELIOTYPE CO., BOSTON.



No. 18.

NICKEL STEEL INGOT.

BLOCK T2. 4½ INCHES FROM THE TOP.

NO. 19.

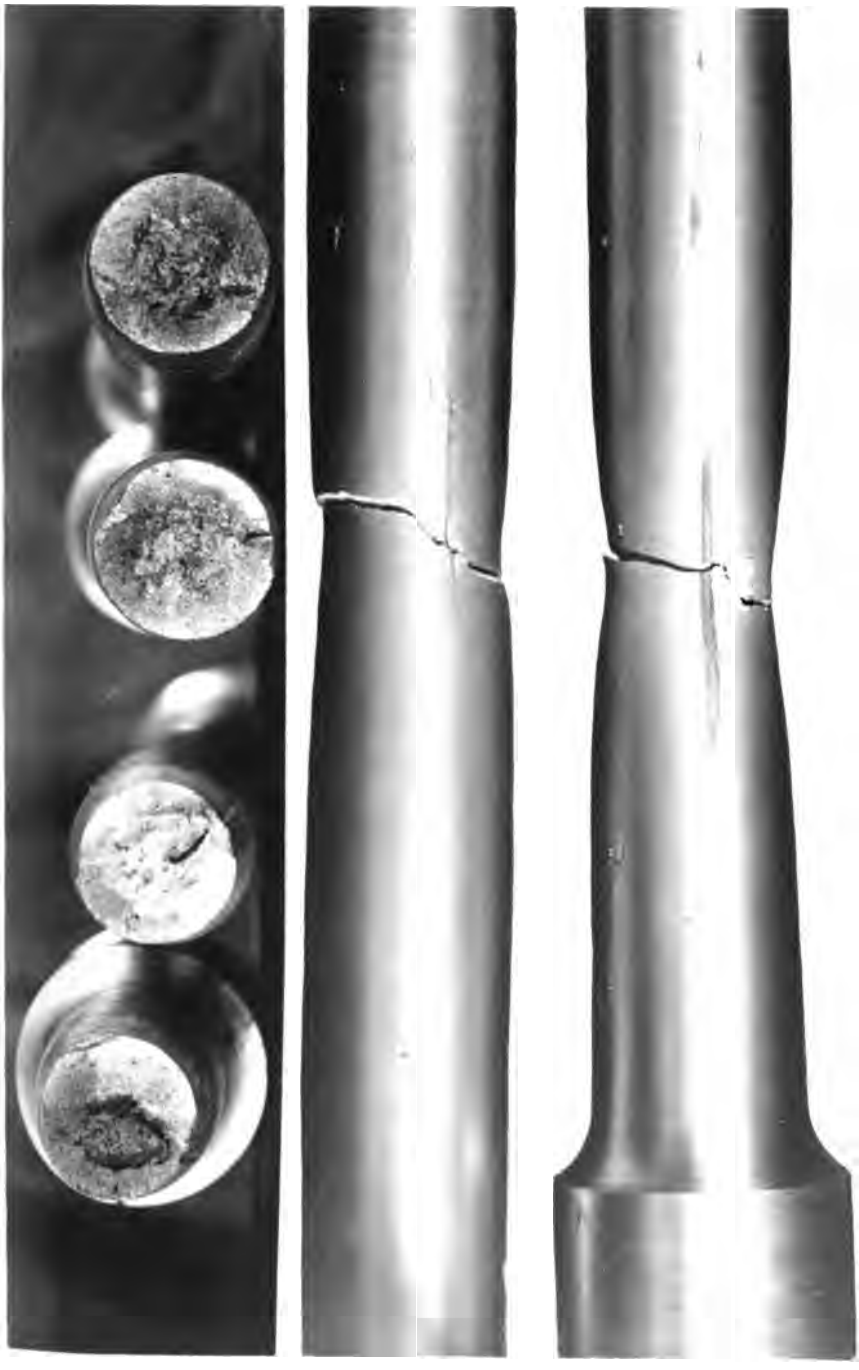
NICKEL STEEL INGOT.

BLOCK T1 ½ INCH FROM THE TOP.

HELIOTYPE CO., BOSTON.

NO. 20.

CARBON STEEL INGOT, BLOCK B4, PIECE A. APPEARANCE AS TAKEN FROM THE INGOT. SUBSEQUENTLY DRAWN OUT IN THE FORGE SHOP, AT A WELDING HEAT, FOR TENSILE SPECIMENS NOS. 7471 AND 7472, AND BAR FOR BENDING TEST.



NO. 21A

CARBON STEEL INGOT

BLOCK B4, PIECE A. FRACTURED TENSILE SPECIMENS NOS. 7171 AND 7172.

NO. 21B.

CARBON STEEL INGOT, BLOCK B4, PIECE A. FINISHED BAR, FOR BENDING TEST.

HELIOTYPE CO., BOSTON.

NO. 22.

NICKEL STEEL INGOT, BLOCK T3, PIECE A. APPEARANCE AS TAKEN FROM INGOT.

NO. 23.

NICKEL STEEL INGOT, BLOCK T3, PIECE A. APPEARANCE AFTER CLOSING CAVITIES, UNDER THE HAMMER AT A FORGING HEAT.

NO. 24.

NICKEL STEEL INGOT, BLOCK T3, PIECE A. APPEARANCE AFTER MACHINING.

SURFACE METAL PLANED OFF AND PIECE CUT APART.

HELIOTYPE CO., BOSTON.

PHOTOMICROGRAPH, CARBON STEEL INGOT, LONGITUDINAL SECTION.
12 IN. FROM BOTTOM OF INGOT, 3-4 IN. FROM EDGE.
MAGNIFICATION 5 DIAMETERS.

HELIOTYPE CO., BOSTON.

PHOTOMICROGRAPH, CARBON STEEL INGOT, LONGITUDINAL SECTION.
12 IN. FROM BOTTOM OF INGOT, 3 IN. FROM EDGE.
MAGNIFICATION 1 DIAMETERS

HELIOTYPE CO., BOSTON

PHOTOMICROGRAPH, CARBON STEEL INGOT. LONGITUDINAL SECTION.
28 IN. FROM BOTTOM OF INGOT, 1 1-4 IN. FROM EDGE.
MAGNIFICATION 5 DIAMETERS.

HELIOTYPE CO., BOSTON.

CARBON STEEL INGOT.

PHOTOMICROGRAPH, 12 INCHES FROM TOP OF INGOT, 4½ INCHES FROM SIDE,
LONGITUDINAL SECTION. MAGNIFICATION 5 DIAMETERS.

HELIOTYPE CO., BOSTON

CARBON STEEL INGOT.

PHOTOMICROGRAPH, 12 INCHES FROM TOP OF INGOT, AT EDGE OF CENTRAL CAVITY, 2½ INCHES DIAMETER, LONGITUDINAL SECTION. MAGNIFICATION 5 DIAMETERS.

HELIOTYPE CO., BOSTON.

PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-A, NO. 7568, CROSS SECTION,
CARBON STEEL INGOT. MAGNIFICATION 56 DIAMETERS
STEEL IN NATURAL STATE. THREE VIEWS, 1.

HELIOTYPE CO., BOSTON.

PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-A, NO. 7508, CROSS SECTION.
CARBON STEEL INGOT. MAGNIFICATION 56 DIAMETERS.
STEEL IN NATURAL STATE. THREE VIEWS, 2.

HELIOTYPE CO., BOSTON.

PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-A, NO. 5-B,
CARBON STEEL INGOT. CROSS SECTION. STEEL IN NATURAL STATE.
MAGNIFICATION 5 DIAMETERS. THREE VIEWS, 3.

METAL FROM CARBON STEEL INGOT, SLAB NO. 2.

No. 7568.

Longitudinal specimen.
Natural state.
Marks, C2-A.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
15,000	.0018	.0001	
16,000	.0020	.....	
17,000	.0022	.....	Elastic limit.
18,000	.0030	.....	
19,000	.0041	.....	
20,000	.0065	.0040	
22,000	.0099	.....	
24,000	.0150	.....	
26,000	.0222	.....	
28,000	.0295	.....	
30,000	.0386	.0347	
32,000	.0475	.....	
34,000	.0563	.....	
36,000	.0670	.....	
38,000	.0810	.....	
40,000	.0950	.0894	
42,000	.11	.....	
44,000	.14	.....	
46,000	.16	.....	
48,000	.18	.....	
50,000	.22	.....	
52,000	.27	.....	
54,000	.35	.....	
54,880	.....	.....	Tensile strength.
0	.45	.....	= 15 per cent.

Elongation of inch sections, ".13, ".13, ".19*.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured ".50 from the neck.
Appearance, dull, amorphous, oblique.

No. 7569.

Longitudinal specimen.
Natural state.
Marks, C2-D.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0011	0.	
15,000	.0019	.0001	
16,000	.0023	.....	Elastic limit.
17,000	.0030	.....	
18,000	.0043	.....	
19,000	.0056	.....	
20,000	.0075	.0061	
22,000	.0119	.....	
24,000	.0183	.....	
26,000	.0258	.....	
28,000	.0332	.....	
30,000	.0428	.0389	
32,000	.0520	.....	
34,000	.0638	.....	
36,000	.0760	.....	
38,000	.0891	.....	
40,000	.1069	.1012	
42,000	.13	.....	
44,000	.15	.....	
46,000	.18	.....	
48,000	.21	.....	
50,000	.26	.....	
52,000	.33	.....	
53,120	.....	.....	Tensile strength.
0	.43	.....	=14.3 per cent.

Elongation of inch sections, ".13, ".13, ".17*.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured ".50 from the neck.
Appearance, coarse granular, silvery luster.

No. 7570.

Longitudinal specimen.
Natural state.
Marks, C2-F.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0005	0.	
10,000	.0011	0.	
15,000	.0019	.0001	
16,000	.0020	.....	Elastic limit.
17,000	.0028	.....	
18,000	.0041	.....	
19,000	.0058	.....	
20,000	.0086	.0061	
22,000	.0135	.....	
24,000	.0196	.....	
26,000	.0280	.....	
28,000	.0360	.....	
30,000	.0460	.0421	
32,000	.06	.....	
34,000	.08	.....	
36,000	.09	.....	
38,000	.10	.....	
40,000	.12	.....	
42,000	.14	.....	
44,000	.17	.....	
46,000	.20	.....	
47,600	.....	.....	Tensile strength.
0	.31	.....	=10.3 per cent.

Defective specimen, spongy.
Elongation of inch sections, ".08, ".15*, ".08.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Fractured at the middle of the stem.
Appearance, dull, amorphous, oblique.

No. 7571.

Transverse specimen.
Natural state.
Marks, C2-H.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
15,000	.0019	0.	
16,000	.0020	.....	Elastic limit.
17,000	.0028	.....	
18,000	.0039	.....	
19,000	.0050	.....	
20,000	.0069	.0048	
22,000	.0120	.....	
24,000	.0180	.....	
26,000	.0252	.....	
28,000	.0328	.....	
30,000	.0422	.0382	
32,000	.0511	.....	
34,000	.0629	.....	
36,000	.0750	.....	
38,000	.0888	.....	
40,000	.1049	.0992	
42,000	.13	.....	
44,000	.15	.....	
46,000	.17	.....	
48,000	.20	.....	
50,000	.25	.....	
52,000	.32	.....	
52,800	.....	.....	Tensile strength.
0	.40	.....	=13.3 per cent.

Elongation of inch sections, ".11, ".11, ".18*.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured ".30 from the neck.
Appearance, dull, amorphous, in part granular.

No. 7572.

Transverse specimen.
Natural state.
Marks, C2-K.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	0.	
15,000	.0014	0.	Elastic limit.
16,000	.0020	.....	
17,000	.0027	.....	
18,000	.0039	.....	
19,000	.0050	.....	
20,000	.0071	.0049	
22,000	.0128	.....	
24,000	.0185	.....	
26,000	.0260	.....	
28,000	.0335	.....	
30,000	.0440	.0408	
32,000	.0555	.....	
34,000	.0633	.....	
36,000	.0755	.....	
38,000	.0912	.....	
40,000	.1072	.1018	
42,000	.13	.....	
44,000	.15	.....	
46,000	.17	.....	
48,000	.20	.....	
50,000	.25	.....	
52,000	.30	.....	
54,000	.39	.....	
54,400	.....	.....	Tensile strength.
0	.46	.....	= 15.3 per cent.

Elongation of inch sections, ".13, ".20*, ".13.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per eent.
Fractured 1".3 from the neck.
Appearance, coarse granular.

No. 7573.

Longitudinal specimen.
Natural state.
Marks, C2-M.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	0.	
15,000	.0016	0.	
16,000	.0018	.....	Elastic limit
17,000	.0029	.....	
18,000	.0039	.....	
19,000	.0050	.....	
20,000	.0070	.0048	
22,000	.0118	....	
24,000	.0180	.....	
26,000	.0250	.....	
28,000	.0330	.....	
30,000	.0425	.0387	
32,000	.0619	.....	
34,000	.0639	.....	
36,000	.0773	....	
38,000	.0905	.....	
40,000	.1093	.1036	
42,000	.13	.....	
44,000	.15	.....	
46,000	.18	.....	
48,000	.22	.....	
50,000	.26	.....	
52,000	.33	.....	
54,000	.46	.....	Tensile strength.
0	.51	.....	= 17 per cent.

Elongation of inch sections, ".18*, ".18, ".15.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Fractured 1".14 from the neck.
Appearance, dull, amorphous, in part granular.

No. 7574.

Longitudinal specimen.
Natural state.
Marks, C2-P.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
15,000	.0019	.0001	Elastic limit.
16,000	.0026	.....	
17,000	.0031	.....	
18,000	.0041	.....	
19,000	.0058	.....	
20,000	.0078	.0052	
22,000	.0120	.....	
24,000	.0195	.....	
26,000	.0273	.....	
28,000	.0348	.....	
30,000	.0429	.0390	
32,000	.0550	.....	
34,000	.0648	.....	
36,000	.0770	.....	
38,000	.0919	.....	
40,000	.1078	.1020	
42,000	.13	.....	
44,000	.15	.....	
46,000	.18	.....	
48,000	.21	.....	
50,000	.25	.....	
52,000	.31	.....	
58,400	.....	.....	Tensile strength.
0	.45	.....	=15 per cent.

Elongation of inch sections, ".11, ".12, ".22*.
Diameter at fracture, ".48; area, .1810 square inch.
Contraction of area, 27.6 per cent.
Fractured, ".25 from the neck.
Appearance, dull amorphous, oblique.

No. 7575.

Longitudinal specimen.
Natural state.
Marks, C2-R.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0011	0.	
15,000	.0018	.0001	
16,000	.0020	.....	
17,000	.0021	.....	Elastic limit.
18,000	.0028	.....	
19,000	.0039	.....	
20,000	.0059	.0037	
22,000	.0100	.....	
24,000	.0170	.....	
26,000	.0288	.....	
28,000	.0322	.....	
30,000	.0402	.0368	
32,000	.0500	.....	
34,000	.0605	.....	
36,000	.0710	.....	
38,000	.0845	.....	
40,000	.0980	.0929	
42,000	.12	.....	
44,000	.14	.....	
46,000	.16	.....	
48,000	.19	.....	
50,000	.22	.....	
52,000	.27	.....	
54,000	.33	.....	
55,280	.....	.....	Tensile strength.
0	.46	.....	= 15.3 per cent.

Defective specimen, spongy.
Elongation of inch sections, ".13, ".20*, ".13.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured 1".5 from the neck.
Appearance, dull, amorphous, trace of granulation.

No. 7579.

Longitudinal specimen.
Heated full cherry and quenched in oil.
Marks, C2-Q.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
20,000	.0019	0.	
25,000	.0026	.....	
30,000	.0033	.0002	
35,000	.0042	.0009	
40,000	.0054	.0013	
45,000	.0070	.0022	
50,000	.0095	.0041	
52,000	.0110	.....	
54,000	.0130	.....	
56,000	.0165	.....	
58,000	.0220	.....	
60,000	.0279	.0210	
64,000	.04	.....	
68,000	.06	.....	
72,000	.08	.....	
76,000	.11	.....	
77,440	.....	.....	Tensile strength.
0	.16	.....	=5.3 per cent.

Elongation of inch sections, ".05, ".04, ".07*.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured ".85 from the neck.
Appearance, dull, amorphous, contains a spot of granular metal.

No. 7578.

Longitudinal specimen.
Heated full cherry, quenched in oil, and annealed at about 1,000° F.
Marks, C2-E.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0020	.....	
29,000	.....	.....	Elastic limit, approximate.
30,000	.0041	.0010	
31,000	.0046	.....	
32,000	.0050	.....	
33,000	.0053	.....	
34,000	.0056	.....	
35,000	.0060	.0021	
36,000	.0067	.....	
37,000	.0071	.....	
38,000	.0078	.....	
39,000	.0088	.....	
40,000	.0100	.0055	
42,000	.0130	.....	
44,000	.0198	.....	
46,000	.0306	.....	
48,000	.0460	.....	
50,000	.0550	.0489	
52,000	.07	.....	
56,000	.09	.....	
60,000	.11	.....	
64,000	.15	.....	
68,000	.21	.....	
68,080	.....	.....	Tensile strength.
0	.28	.....	=9.3 per cent.

Elongation of inch sections, ".16*, ".05, ".07.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Fractured ".25 from the neck.
Appearance, dull, amorphous, oblique.

No. 7582.

Transverse specimen.
Heated low yellow and quenched in oil.
Marks, C2-J.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0032	.0001	
35,000	.0040	.....	
40,000	.0046	.0002	
45,000	.0051	.....	
50,000	.0058	.0004	
55,000	.0069	.....	
60,000	.0260	.0189	
62,000	.0318	.....	
64,000	.0392	.....	
66,000	.0480	.....	
68,000	.0550	.....	
70,000	.0643	.0551	
72,000	.07	.....	
76,000	.10	.....	
80,000	.13	.....	
84,000	.17	.....	
85,600	.....	.....	Tensile strength.
0	.27	.....	= 9 per cent.

Elongation of inch sections, ".04, ".13*, ".10.
Diameter at fracture, ".51; area, .2043 square inch.
Contraction of area, 18.3 per cent.
Fractured 1".14 from the neck.
Appearance, dull, amorphous, oblique.

No. 7584.

Longitudinal specimen.
Heated low yellow and quenched in oil.
Marks, C2-N.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.0001	
35,000	.0037	.....	
40,000	.0043	.0001	
45,000	.0050	.0002	
50,000	.0056	.0004	
55,000	.0067	.0008	
56,000	.0069	.....	
57,000	.0072	.....	
58,000	.0120	.....	
59,000	.0171	.....	
60,000	.0230	.0158	
62,000	.0268	.....	
64,000	.0340	.....	
66,000	.0410	.....	
68,000	.0482	.....	
70,000	.0578	.0490	
72,000	.07	.....	
76,000	.09	.....	
80,000	.11	.....	
84,000	.15	.....	
86,400	.....	.....	Tensile strength.
0	.24	.....	= 8 per cent.

Elongation of inch sections, ".05, ".07, ".12*.
Diameter at fracture, ".51; area, .2043 square inch.
Contraction of area, 18.3 per cent.
Fractured ".75 from the neck.
Appearance, dull, amorphous, irregular surface.

No. 7583.

Transverse specimen.
Heated low yellow, quenched in oil, and annealed at about 1,000° F.
Marks, C2-L.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	0.	
35,000	.0036	0.	
40,000	.0041	0.	
45,000	.0047	0.	
50,000	.0051	0.	
53,000	.0054	.....	
54,000	.0056	.....	Elastic limit.
55,000	.0090	.....	Load fell.
50,000	.0112	.....	
51,000	.0140	.....	
52,000	.0190	.....	
53,000	.0282	.....	
54,000	.0400	.....	
56,000	.0490	.....	
58,000	.0561	.....	
60,000	.0672	.0691	
64,000	.09	.....	
68,000	.11	.....	
72,000	.15	.....	
76,000	.23	.....	
77,200	.....	.....	Tensile strength.
0	.35	.....	=11.7 per cent.

Elongation of inch sections, ".08, ".07, ".20*.
Diameter at fracture, ".48; area, .1810 square inch.
Contraction of area, 27.6 per cent.
Fractured ".7 from the neck.
Appearance, dull, amorphous, irregular surface.

No. 7585.

Longitudinal specimen.
Heated low yellow, quenched in oil, and annealed at about 1,000° F.
Marks, C2-O.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.	
35,000	.0034	.....	
40,000	.0040	0.	
45,000	.0044	.....	
50,000	.0050	0.	
53,000	.0053	.....	Elastic limit. Load fell.
50,000	.0125	.....	
51,000	.0170	.....	
52,000	.0360	.....	
53,000	.0400	.....	
54,000	.0448	.....	
56,000	.0522	.....	
58,000	.0620	.....	
60,000	.0706	.0628	
62,000	.0810	.....	
64,000	.0923	.....	
66,000	.1060	.....	
68,000	.1210	.....	
72,000	.16	.....	
76,000	.25	.....	
76,800	.....	.....	Tensile strength.
0	.35	.....	=11.7 per cent.

Elongation of inch sections, ".10, ".17*, ".08.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Fractured 1".37 from the neck.
Appearance, dull, amorphous, irregular surface.

PHOTOMICROGRAPH OF STEM OF TENSILE SPECIMEN C2-B, NO. 7576, CROSS SECTION,
CARBON STEEL INGOT. MAGNIFICATION 180 DIAMETERS.
STEEL HEATED BRIGHT YELLOW AND QUENCHED IN OIL.

HELIOTYPE CO., BOSTON.

No. 7576.

Longitudinal specimen.
Heated bright yellow and quenched in oil.
Marks, C2-B.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Inital load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0033	.0001	
40,000	.0048	.0005	
45,000	.0054	.0009	
50,000	.0063	.0012	
55,000	.0079	.....	
60,000	.0102	.0038	
65,000	.0140	.....	
70,000	.0225	.0139	
75,000	.0333	.....	
80,000	.0530	.0428	
84,000	.07	.....	
88,000	.10	.....	
92,000	.13	.....	
98,040	.....	.....	Tensile strength.
0	.17	.....	= 5.7 per cent.

Elongation of inch sections, ".04, ".04, ".09*.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured ".8 from the neck.
Appearance, dull, amorphous, oblique.

No. 7580.

Transverse specimen.
Heated bright yellow and quenched in oil.
Marks, C2-G.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0002	0.	
10,000	.0008	.....	
20,000	.0019	.....	
30,000	.0030	0.	
35,000	.0037	.....	
40,000	.0043	.0002	
45,000	.0051	.0005	
50,000	.0060	.0009	
55,000	.0079	.....	
60,000	.0092	.0029	
65,000	.0120	.....	
70,000	.0210	.0130	
75,000	.0342	.....	
80,000	.0520	.0422	
84,000	.07	.....	
88,000	.09	.....	
92,000	.12	.....	
94,400	.....	.....	Tensile strength.
0	.16	.....	= 5.8 per cent.

Elongation of inch sections, ″.07*, ″.07*, ″.02.
Diameter at fracture, ″.54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Fractured 1″.07 from the neck.
Appearance, fine granular, dull spot at the circumference.

No. 7577.

Longitudinal specimen.
Heated bright yellow, quenched in oil, and annealed at about 1,000° F.
Marks, C2-C.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0031	0.	
35,000	.0038	.....	
40,000	.0042	0.	
45,000	.0049	.....	
48,000	.0053	.....	Elastic limit.
49,000	.0063	.....	
50,000	.0081	.0029	
51,000	.0092	.....	
52,000	.0110	.....	
54,000	.0160	.....	
56,000	.0262	.....	
58,000	.0843	.....	
60,000	.0448	.0370	
64,000	.06	.....	
68,000	.09	.....	
72,000	.12	.....	
76,000	.18	.....	
76,480	.....	.....	Tensile strength.
0	.33	.....	=11 per cent.

Elongation of inch sections, ".04, ".07, ".22*.
Diameter at fracture, ".43; area, .1452 square inch.
Contraction of area, 41.9 per cent.
Fractured ".8 from the neck.
Appearance, dull, silky, oblique.

No. 7581.

Transverse specimen.
Heated bright yellow, quenched in oil, and annealed at about 1,000° F.
Marks, C2-I.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	0.	
35,000	.0036	.....	
40,000	.0041	0.	
45,000	.0047	.....	
50,000	.0062	.0001	
53,000	.0055	.....	
54,000	.0058	.....	Elastic limit.
55,000	.0114	.0054	
56,000	.0153	.....	
57,000	.0200	.....	
58,000	.0238	.....	
59,000	.0280	.....	
60,000	.0332	.0260	
62,000	.0388	.....	
64,000	.0490	.....	
66,000	.0580	.....	
68,000	.0663	.....	
72,000	.09	.....	
76,000	.12	.....	
80,000	.16	.....	
83,640	.....	.....	Tensile strength.
0	.32	.....	= 10.7 per cent.

Elongation of inch sections, ".10, ".15*, ".07.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Fractured 1".8 from the neck.
Appearance, dull, amorphous, oblique.

2.

, manganese .58.

wenching on the curves

nit quenched in oil.

" " " "

" " " "

11 12

manganese .58.

arching on the curves

oil, annealed at 1000° ± F.

" " " " "

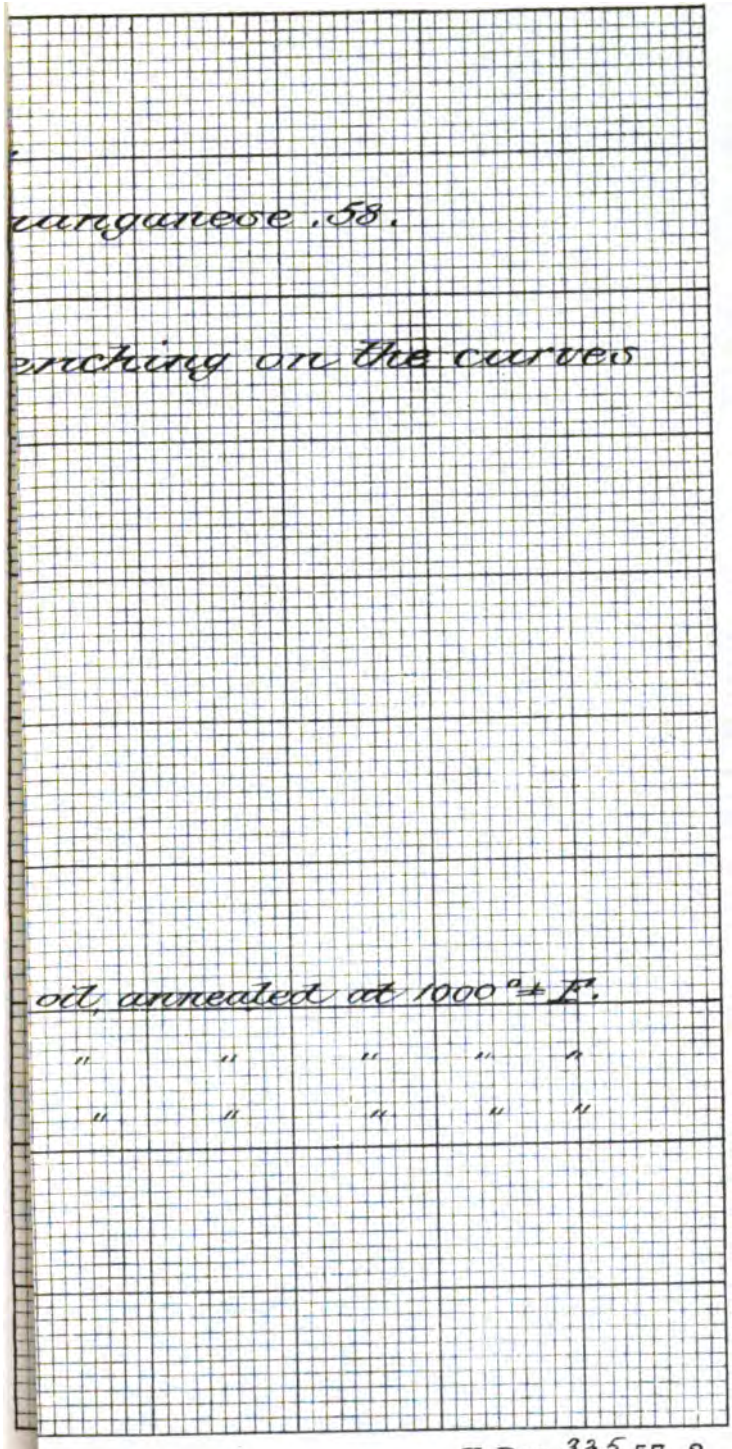
" " " " "

No. 7585.

Longitudinal specimen.
Heated low yellow, quenched in oil, and annealed at about 1,000° F.
Marks, C2-O.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	0.	
35,000	.0034	.....	
40,000	.0040	0.	
45,000	.0044	.....	
50,000	.0050	0.	
53,000	.0053	.....	Elastic limit. Load fell.
50,000	.0125	.....	
51,000	.0170	.....	
52,000	.0360	.....	
53,000	.0400	.....	
54,000	.0448	.....	
56,000	.0522	.....	
58,000	.0620	.....	
60,000	.0706	.0628	
62,000	.0810	.....	
64,000	.0923	.....	
66,000	.1060	.....	
68,000	.1210	.....	
72,000	.16	.....	
76,000	.25	.....	
76,800	.....	.....	Tensile strength.
0	.35	.....	11.7 per cent.

Elongation of inch sections, ".10, ".17*, ".08.
Diameter at fracture, ".49; area, .1886 square inch.
Contraction of area, 24.6 per cent.
Fractured 1".37 from the neck.
Appearance, dull, amorphous, irregular surface.


anganese, 58.
arching on the curves
oil, annealed at 1000° ± F.
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TABULATION OF TENSION SPECIMENS FROM CARBON STEEL INGOT.

STEMS OF SPECIMENS ".564 DIAM., 3" LONG.

No. of test.	Direction of specimen.	Treatment.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3 inches.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Pounds.	*Pounds.*	*Per ct.*	*Per ct.*	*Inch.*	
7568	Longitudinal.	Natural state	17,000	54,880	15.0	21.4	.13,.13,.19*	Dull, amorphous, oblique.
7569	.....do.....	.....do	16,000	53,120	14.3	21.4	.13,.13,.17*	Coarse granular, silvery luster.
7570	.....do.....	Natural state. Defective specimen	16,000	47,600	10.3	24.6	.08,.15*,.08	Dull, amorphous, oblique.
7571	Transverse ...	Natural state	16,000	52,800	13.3	21.4	.11,.11,.18*	Dull, amorphous, in part granular.
7572	.....do.....	.....do	15,000	54,400	15.3	21.4	.13,.20*,.13	Coarse granular.
7573	Longitudinal.	.....do	16,000	54,000	17.0	24.6	.18*,.18,.15	Dull, amorphous, in part granular.
7574	.....do.....	.....do	15,000	53,400	15.0	27.6	.11,.12,.22*	Dull, amorphous, oblique.
7575	.....do.....	Natural state. Spongy specimen	17,000	55,280	15.3	21.4	.13,.20*,.13	Dull, amorphous, trace of granulation.
7579	.....do.....	Heated full cherry and quenched in oil	(*b*)	77,440	5.3	15.0	.05,.04,.07*	Dull, amorphous, granular spot.
7578	.....do.....	Heated full cherry, quenched in oil, and annealed at about 1,000° F.	*a* 29,000	68,080	9.3	24.6	.16*,.05,.07	Dull, amorphous, oblique.
7582	Transverse ...	Heated low yellow and quenched in oil	(*b*)	85,600	9.0	18.3	.04,.13*,.10	Do.
7584	Longitudinal.	.....do	(*b*)	86,400	8.0	18.3	.05,.07,.12*	Dull, amorphous, irregular surface.
7583	Transverse ...	Heated low yellow, quenched in oil, and annealed at about 1,000° F.	54,000	77,200	11.7	27.6	.08,.07,.20*	Do.
7585	Longitudinal.	.....do	53,000	76,800	11.7	24.6	.10,.17*,.08	Do.
7576	.....do.....	Heated bright yellow and quenched in oil	(*b*)	93,040	5.7	15.0	.04,.04,.09*	Dull, amorphous, oblique.
7580	Transverse ...	.....do	(*b*)	94,400	5.3	8.4	.07*,.07*,.02	Fine granular, dull spot.
7577	Longitudinal.	Heated bright yellow, quenched in oil, and annealed at about 1,000° F.	48,000	76,480	11.0	41.9	.04,.07,.22*	Dull silky, oblique.
7581	Transverse ...	.....do	54,000	83,640	10.7	24.6	.10,.15*,.07	Dull, amorphous, oblique.

a Approximate. *b* Indefinite.

METAL FROM NICKEL STEEL INGOT, SLAB NO. 2.

No. 7516.

Longitudinal specimen.
Natural state.
Marks, N2-A.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0014	0.	
20,000	.0020	0.	
25,000	.0025	0.	
30,000	.0031	0.	
32,000	.0034	.....	Elastic limit.
33,000	.0039	.....	
34,000	.0041	.....	
35,000	.0052	.....	
36,000	.0057	.....	
37,000	.0064	.....	
38,000	.0073	.....	
39,000	.0088	.....	
40,000	.0123	.0079	
42,000	.0190	.....	
44,000	.0320	.....	
46,000	.0455	.....	
48,000	.0585	.....	
50,000	.0730	.....	
52,000	.08	.....	
54,000	.10	.....	
56,000	.13	.....	
58,000	.17	.....	
60,000	.20	.....	
62,000	.25	.....	
64,000	.32	.....	
66,000	.45	.....	
66,320	.....	.....	Tensile strength.
0	.64	.....	= 21.3 per cent.

Elongation of inch sections, ".30*, ".19, ".15.
Diameter at fracture, ".47; area, .1735 square inch.
Contraction of area, 30.6 per cent.
Fractured ".45 from the neck.
Appearance, dull leaden color, amorphous, trace of granulation.

No. 7517.

Longitudinal specimen.
Natural state.
Marks, N2-D.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	
31,000	.0032	.....	Elastic limit (not well defined)..
32,000	.0035	.....	
33,000	.0039	.....	
34,000	.0041	.....	
35,000	.0043	.0006	
36,000	.0050	.....	
37,000	.0054	.....	
38,000	.0065	.....	
39,000	.0078	.....	
40,000	.0101	.0055	
42,000	.0155	.....	
44,000	.0290	.....	
46,000	.0405	.....	
48,000	.0528	.....	
50,000	.0670	.0606	
52,000	.08	.....	
54,000	.10	.....	
56,000	.12	.....	
58,000	.15	.....	
60,000	.19	.....	
62,000	.23	.....	
64,000	.30	.....	
66,000	.49	.....	Tensile strength.
0	.60	.....	= 20 per cent.

Elongation of inch sections, ".16, ".17, ".27*.
Diameter at fracture, ".45; area, .1590 square inch.
Contraction of area, 36.4 per cent.
Fractured 1".12 from the neck.
Appearance, dull silky, oblique, small, light-colored spots.

No. 7518.

Longitudinal specimen. Defective.
Natural state.
Marks, N2-F.
Diameter, ".564.
Sectional area, .25 square inches.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0021	0.	
25,000	.0028	.0001	Elastic limit.
26,000	.0033	.....	
27,000	.0038	.....	
28,000	.0042	.....	
29,000	.0049	.....	
30,000	.0059	.0020	
31,000	.0069	.....	
32,000	.0080	.....	
33,000	.0096	.....	
34,000	.0118	.....	
35,000	.0144	.0101	
36,000	.0172	.....	
37,000	.0198	.....	
38,000	.0247	.....	
39,000	.0290	.....	
40,000	.0406	.0351	
42,000	.06	.....	Tensile strength.
0	.11	.....	=3.7 per cent.

Elongation of inch sections, ".02, ".08*, ".01.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured 1".4 from the neck, at group of blow holes.
Appearance, dull, amorphous.

No. 7519.

Transverse specimen.
Natural state.
Marks, N2-H.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	
31,000	.0032	.....	
32,000	.0034	.....	Elastic limit.
33,000	.0037	.....	
34,000	.0040	.....	
35,000	.0043	.0007	
36,000	.0052	.....	
37,000	.0059	.....	
38,000	.0070	.....	
39,000	.0083	.....	
40,000	.0111	.0069	
42,000	.0190	.....	
44,000	.0295	.....	
46,000	.0436	.....	
48,000	.0540	.....	
50,000	.0693	.0629	
52,000	.08	.....	
54,000	.10	.....	
56,000	.12	.....	
58,000	.15	.....	
60,000	.19	.....	
62,000	.23	.....	
64,000	.30	.....	
66,000	.48	.....	
66,800	.....	.....	Tensile strength.
0	.61	.....	=20.3 per cent.

Elongation of inch sections, ".15, ".32*, ".14.
Diameter at fracture, ".45; area, .1590 square inch.
Contraction of area, 36.4 per cent.
Fractured at the middle of the stem.
Appearance, dull, amorphous, flaky.

No. 7520.

Transverse specimen.
Natural state.
Marks, N2-K.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0006	0.	
10,000	.0010	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	Elastic limit.
31,000	.0035	.....	
32,000	.0039	.....	
33,000	.0041	.....	
34,000	.0047	.....	
35,000	.0049	.0010	
36,000	.0053	.....	
37,000	.0060	.....	
38,000	.0078	.....	
39,000	.0091	.....	
40,000	.0126	.0061	
42,000	.0190	.....	
44,000	.0310	.....	
46,000	.0445	.....	
48,000	.0580	.....	
50,000	.0742	.0679	
52,000	.09	.....	
54,000	.11	.....	
56,000	.13	.....	
58,000	.17	.....	
60,000	.21	.....	
62,000	.26	.....	
63,600	.....	.....	Tensile strength.
0	.42	.....	= 14 per cent.

Elongation of inch sections, ".11, ".17*, ".14.
Diameter at fracture, ".47; area, .1735 square inch.
Contraction of area, 30.6 per cent.
Fractured 1".2 from the neck.
Appearance, dull silky. Band of light-colored metal across fractured surface.

No. 7521.

Longitudinal specimen.
Natural state.
Marks, N2-M.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Inital load.
5,000	.0004	0.	
10,000	.0010	0.	
20,000	.0021	0.	
25,000	.0027	0.	
30,000	.0038	.0001	
34,000	.0087	.....	Elastic limit.
35,000	.0052	.0012	
36,000	.0060	.....	
37,000	.0070	.....	
38,000	.0079	.....	
39,000	.0096	.....	
40,000	.0137	.0092	
42,000	.0228	.....	
44,000	.0330	.....	
46,000	.0433	.....	
48,000	.0550	.....	
50,000	.0713	.0649	
52,000	.09		
54,000	.11	.....	
56,000	.13	.....	
58,000	.17	.....	
58,800	.....	.....	Tensile strength.
0	.19	.....	=6.3 per cent.

Elongation of inch sections, ".05, ".09*, ".05.
Diameter at fracture, ".54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Fractured 1".4 from the neck.
Appearance, granular 80 per cent, amorphous, flaky, 20 per cent.

No. 7522.

Longitudinal specimen.
Natural state.
Marks, N2-P.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads, per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0033	.0001	Elastic limit.
31,000	.0038	.....	
32,000	.0041	.....	
33,000	.0044	.....	
34,000	.0049	.....	
35,000	.0056	.0017	
36,000	.0067	.....	
37,000	.0074	.....	
38,000	.0089	.....	
39,000	.0102	.....	
40,000	.0150	.0102	
42,000	.0240	.....	
44,000	.0340	.....	
46,000	.0465	.....	
48,000	.0610	.....	
50,000	.0866	.0801	
50,400	.....	.....	Tensile strength.
0	.14	.....	= 4.7 per cent.

Elongation of inch sections, ".03, ".09*, ".02.
Diameter at fracture, ".53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Fractured 1".4 from the neck.
Appearance, granular, 60 per cent; belts of light and dark colored amorphous metal, 40 per cent.

NO. 75 0. NS-K.

FRACTURED

No. 7532.

Longitudinal specimen.
Heated full cherry and quenched in oil.
Marks, N2-Q.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0034	.0002	
35,000	.0043	.....	
40,000	.0052	.0010	
45,000	.0061	.....	
50,000	.0071	.0019	
55,000	.0082	.....	
60,000	.0098	.0030	
65,000	.0111	.....	
70,000	.0131	.0061	
75,000	.0152	.....	
80,000	.0184	.0091	
85,000	.0225	.....	
90,000	.0282	.0172	
95,000	.0338	.....	
100,000	.0435	.0309	
104,000	.05	.....	
108,000	.07	.....	
112,000	.09	.....	
115,200	.....	.....	Tensile strength.
0	.13	.....	= 4.3 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".03, ".07*, ".03.
Diameter at fracture, ".53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Fractured 1".3 from the neck.
Appearance, dull silky, coarsely serrated. Two minute discolored spots at circumference.

No. 7525.

Longitudinal specimen.
Heated full cherry, quenched in oil, and annealed at 1,000° ± F.
Marks, N2-E.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0032	0.	
35,000	.0037	.....	
40,000	.0043	0.	
50,000	.0053	0.	
60,000	.0063	0.	
70,000	.0073	0.	
76,000	.0086	.....	Elastic limit about 75,000 pounds per square inch.
78,000	.0092	.....	
80,000	.0100	.0014	
81,000	.0110	.....	
82,000	.0120	.....	
83,000	.0132	.....	
84,000	.0160	.....	
85,000	.0181	.....	
86,000	.0215	.....	
88,000	.0350	.....	
90,000	.0518	.0407	
92,000	.07	.....	
96,000	.11	.....	
100,000	.19	.....	
101,200	.....	.....	Tensile strength.
0	.37	.....	= 12.3 per cent.

Elongation of inch sections, ".04, ".10, ".23*.
Diameter at fracture, ".41; area, .1320 square inch.
Contraction of area, 47.2 per cent.
Fractured ".5 from the neck.
Appearance, dull silky, oblique.

No. 7533.

Longitudinal specimen.
Heated full cherry, quenched in oil, and annealed at 1,000° ± F.
Marks, N2-R.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0030	0.	
40,000	.0041	0.	
50,000	.0051	0.	
60,000	.0061	0.	
68,000	.0071	.....	Elastic limit.
69,000	.0090	.....	
68,000	.0112	.....	
	.0150	.....	
69,000	.0188	.....	
70,000	.0230	.0150	
72,000	.0272	.....	
74,000	.0332	.....	
76,000	.0475	.....	
78,000	.0608	.....	
80,000	.0726	.0620	
84,000	.12	.....	
88,000	.18	.....	
89,600	.....	.....	Tensile strength.
0	.32	.....	= 10.7 per cent.

Elongation of inch sections, ".04, ".05, ".23*.
Diameter at fracture, ".46; area, .1662 square inch.
Contraction of area, 33.5 per cent.
Fractured ".2 from the neck. Appearance, dull silky; oblique, pitted surface.

No. 7528.

Transverse specimen.
Heated low yellow and quenched in oil.
Marks, N2-J.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0036	.0003	
35,000	.0044	.0007	
40,000	.0050	.0009	
45,000	.0058	.0010	
50,000	.0068	.0012	
55,000	.0077	.0016	
60,000	.0089	.0020	
65,000	.0099	.0025	
70,000	.0111	.0032	
75,000	.0128	.0040	
80,000	.0140	.0050	
85,000	.0160	.0061	
90,000	.0187	.0080	
95,000	.0215	.0100	
100,000	.0251	.0135	
105,000	.0299	.0171	
110,000	.0381	.0246	
110,400	.....	.....	Tensile strength.
0	.06	.....	=2 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".01, ".01, ".04*.
Diameter at fracture, ".55; area, .2376 square inches.
Contraction of area, 5 per cent.
Fractured 1" from the neck.
Appearance, granular; streaks of light-colored metal across fractured surface.

No. 7530.

Longitudinal specimen.
Heated low yellow and quenched in oil.
Marks, N2-N.
Diameter, ".564.
Sectional area, ".25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0022	.....	
30,000	.0038	.0002	
35,000	.0043	.0003	
40,000	.0051	.0007	
45,000	.0060	.0009	
50,000	.0069	.0012	
55,000	.0078	.0015	
60,000	.0087	.0019	
65,000	.0095	.0021	
70,000	.0107	.0029	
75,000	.0119	.0034	
80,000	.0133	.0042	
85,000	.0149	.0050	
90,000	.0168	.0065	
95,000	.0192	.0081	
98,000	.....	.....	Tensile strength.
0	.05	.....	= 1.7 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".04*, ".00, ".01.
Diameter at fracture, ".55; area, .2376 square inch.
Contraction of area, 5 per cent.
Fractured ".75 from the neck.
Appearance, dull silky, trace of granulation.
Defective specimen. A crack ".08 deep with dark-colored walls existed in the stem at the place of fracture. The discoloration was attributed to the operation of heating.

No. 7529.

Transverse specimen.
Heated low yellow, quenched in oil, and annealed at 1,000° ± F.
Marks, N2-L.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0032	0.	
35,000	.0037	.....	
40,000	.0042	0.	
50,000	.0054	0.	
60,000	.0066	0.	
70,000	.0077	.0001	
75,000	.0086	.....	Elastic limit.
76,000	.0092	.....	
77,000	.0120	.....	
78,000	.0175	.....	
79,000	.0228	.....	
80,000	.0300	.0201	
82,000	.0378	.....	
84,000	.0540	.....	
86,000	.0665	.....	
88,000	.0810	.....	
90,000	.1050	.0928	
92,000	.12	.....	
93,680	.....	.....	Tensile strength.
0	.21	.....	=7 per cent.

Elongation of inch sections, ".05, ".11*, ".05.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured 1".48 from the neck.
Appearance, dull silky, oblique. Streak of light-colored metal across fractured surface.

No. 7531.

Longitudinal specimen.
Heated low yellow, quenched in oil, and annealed at 1,000° ± F.
Marks, N2-O.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0031	0.	
35,000	.0037	.....	
40,000	.0042	0.	
45,000	.0049	.....	
50,000	.0054	0.	
55,000	.0060	.....	
60,000	.0067	0.	
65,000	.0076	.0002	Elastic limit.
66,000	.1080	.....	
67,000	.0085	.....	
68,000	.0094	.....	
69,000	.0108	.....	
70,000	.0147	.0058	
71,200	.....	.....	Tensile strength.
0	.05	.....	=1.7 per cent.

Elongations of inch sections, ".00, ".01, ".04*.
Diameter at fracture, ".54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Fractured ".65 from the neck.
Appearance, dull gray, amorphous in part, with streak of light-colored metal.
Defective specimen. Crack with discolored walls $\frac{1}{8}$" by $\frac{3}{8}$".

No. 7523.

Longitudinal specimen.
Heated bright yellow and quenched in oil.
Marks, N2-B.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0032	.0001	
35,000	.0039	.0001	
40,000	.0046	.0002	
45,000	.0053	.0004	
50,000	.0060	.0008	
55,000	.0068	.0009	
60,000	.0076	.0011	
65,000	.0084	.0014	
70,000	.0096	.0019	
75,000	.0103	.0021	
80,000	.0113	.0028	
104,000	.02	.....	
120,000	.03	.....	
132,000	.04	.....	
140,000	.05	.....	
144,000	.07	.....	
148,000	.10	.....	
151,200	.....	.....	Tensile strength.
0	.15	.....	= 5 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".05, ".07*, ".03.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured 1".3 from the neck.
Appearance, granular, cup-shaped.

No. 7526.

Transverse specimen.
Heated bright yellow, quenched in oil.
Marks, N2-G.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0022	.....	
30,000	.0034	.0001	
40,000	.0048	.0004	
50,000	.0061	.0008	
55,000	.0070	.0010	
60,000	.0078	.0011	
65,000	.0085	.0015	
70,000	.0094	.0018	
75,000	.0102	.0021	
80,000	.0112	.0026	
85,000	.0122	.0030	
90,000	.0137	.0039	
95,000	.0147	.0042	
100,000	.0165	.0061	
105,000	.0176	.0061	
110,000	.0197	.0076	
115,000	.0218	.0090	
120,000	.0240	.0108	
125,000	.0270	.0130	
130,000	.0304	.0158	
140,000	.04	.....	
150,000	.06	.....	
156,800	.....	.....	Tensile strength.
0	.12	.....	=4 per cent.

Elastic limit indefinite.
Elongation of inch sections, ".02, ".02, ".08*.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured ".2 from the neck. Appearance, dull gray, slightly granular. General surface close approach to silky.

No. 7524.

Longitudinal specimen.
Heated bright yellow, quenched in oil, and annealed at 1,000° ± F.
Marks, N2-C.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	0.	
40,000	.0040	0.	
50,000	.0051	0.	
60,000	.0061	0.	
70,000	.0071	0.	
72,000	.0074	.....	
74,000	.0077	.....	Elastic limit.
72,000	.0119	.....	Load fell.
73,000	.0134	.....	
74,000	.0170	.....	
75,000	.0198	.....	
76,000	.0290	.....	
78,000	.0389	.....	
80,000	.0510	.0408	
82,000	.0580	.....	
84,000	.0742	.....	
88,000	.11	.....	
92,000	.16	.....	
95,000	.....	.....	Tensile strength
0	.43	.....	=14.3 per cent.

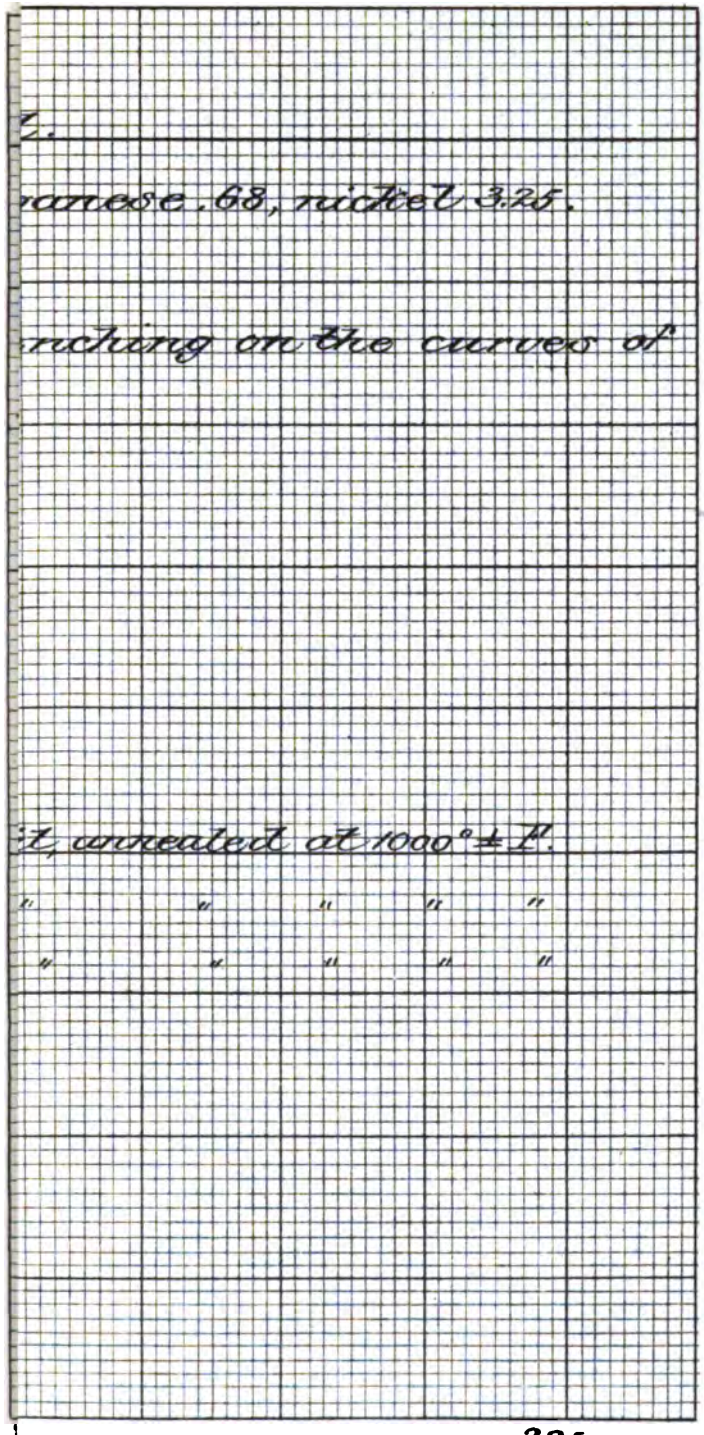
Elongation of inch sections, ".30*, ".08, ".05.
Diameter at fracture, ".41; area, .1320 square inch.
Contraction of area, 47.2 per cent.
Fractured ".75 from the neck. Appearance, dull gray amorphous, oblique. Coarsely serrated.

No. 7527.

Transverse specimen.
Heated bright yellow, quenched in oil, and annealed at 1,000° ± F.
Marks, N2–I.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	0.	
40,000	.0043	0.	
50,000	.0053	.....	
60,000	.0065	0.	
70,000	.0076	0.	
73,000	.0078	.....	
74,000	.0081	.....	Elastic limit.
75,000	.0148	.....	
76,000	.0178	.....	
78,000	.0345	.....	
80,000	.0470	.0370	
84,000	.08	.....	
88,000	.12	.....	
92,000	.18	.....	
94,400	.....	.....	Tensile strength.
0	.57	.....	=19 per cent.

Elongation of inch sections, ".36*, ".13, ".08.
Diameter at fracture, ".37; area, .1075 square inch.
Contraction of area, 57 per cent.
Fractured ".95 from the neck. Appearance, silky. Surface contains several light-colored spots.


2.
ranese .68, nickel 3.25.
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t, annealed at 1000° ± F.
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Carbon Steel Ingot.

Specimens from Block B4″, piece *a*. Metal drawn down at a welding heat in the forge shop to a bar about 1″.5 diameter by 48″ long, from which tensile specimens were taken.

No. 7471.

Marks, Carbon B4–*a*1.
Diameter, 1″.129.
Sectional area, 1.00 square inch.
Length of stem, 18″.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0080	.....	
20,000	.0068	0.	
30,000	.0098	.0001	
35,000	.0116	.0002	
36,000	.0120	.....	Elastic limit.
37,000	.0640	.....	
38,000	.0720	.....	
39,000	.0850	.....	
40,000	.1850	.....	
41,000	.2050	.....	
42,000	.2140	.....	
43,000	.2250	.....	
44,000	.2400	.....	
45,000	.2620	.....	
46,000	.2800	.....	
47,000	.3000	.....	
48,000	.3200	.....	
49,000	.3450	.....	
50,000	.3650	.....	
1,000	.....	.3456	
1,000	.35	.....	Rested 1 hour.
55,000	.54	.....	
60,000	.83	.....	
64,700	.....	.....	Tensile strength.
0	2.43	.....	= 34.3 per cent.

Elongation of inch sections, ″.20, ″.21, ″.21, ″.18, ″.19, ″.19, ″.19, ″.18, ″.20, ″.40*, ″.30, ″.21, ″.20, ″.21, ″.19, ″.17.

Diameter at fracture, ″.88; area, .6082 square inch.

Contraction of area, 39.2 per cent.

Appearance of fracture, silky, containing a seam about ″.15 deep near the circumference.

No. 7472.

Marks, Carbon B4–*a*2.
Diameter, 1″.129.
Sectional area, 1.00 square inch.
Length of stem, 18″.
Gauged length, 10″.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0014	0.	
10,000	.0032	.....	
20,000	.0066	.....	
30,000	.0100	0.	
35,000	.0115	.0001	
40,000	.0132	.0001	
41,000	.0135	.....	Elastic limit.
42,000	.2500	.....	
43,000	.2640	.....	
44,000	.2800	.....	
45,000	.3000	.....	
46,000	.3210	.....	
47,000	.3450	.....	
48,000	.3610	.....	
49,000	.3815	.....	
50,000	.5075	.....	
1,000	.....	.4032	
1,000	.42	.....	Rested 1 hour.
55,000	.55	.....	
60,000	1.07	.....	
62,400	.....	.....	Tensile strength.
0	3.36	.....	= 33.6 per cent.

Elongation of inch sections, ″.12, ″.13, ″.17, ″.18, ″.19, ″.19, ″.17, ″.18, ″.17, ″.18, ″.19, ″.18, ″.21, ″.19, ″.40, ″.51*.
Diameter at fracture, ″.78; area, .4778 square inch.
Contraction of area, 52.2 per cent.
Appearance of fracture, silky, containing a seam about ″.40 deep.

BENDING TEST.

Specimen from Block B4, piece *b*, was drawn out under the hammer to a bar 28″.75 long, and which finished 1″.62 by 1″.75 in cross-section dimensions. This bar was bent cold through 180 degrees and closed down without rupture. Minute longitudinal lines, dark in color, appeared on the tension side of the bend.

STEEL SUSPENDER RODS FROM NEW YORK AND BROOKLYN BRIDGE.

STEEL SUSPENDER RODS FROM THE NEW YORK AND BROOKLYN BRIDGE.

Tests having reference to the strength of suspender rods, seven of which in the bridge were found broken July 24, 1901.

Elongations and sets determined during the progress of the tests were by means of observations made upon the movable head of the testing machine.

The rods were pulled by attaching special fixtures to a pin passing through the eye at the head of the rod at one end and pulling against the nut on the opposite end, thus applying loads in the same manner direct tensile stresses would be received by the rods in place in the bridge.

The attachment employed to secure the rods to the testing machi rendered the test pieces inaccessible at the time.

Incipient cracks at the roots of the threads in the old rods, Nos 5, 6, and 8, were developed by the tests. The cracks extended arou part of the circumference of the rods, but were generally located the extremities of the diameter which was parallel to the axis of t bridge. These cracks were seldom found on the sides of the r taken crosswise the direction of the length of the bridge Their position is regarded as significant with reference to explainin causes which contributed to the failure in service of some of the r by indicating the direction in which the overstraining forces acted.

The direct tensile stress on the suspender rods in service, under normal conditions of loading, is stated to be 11 tons.

ROD NO. 1, WITH NEW WELDED END

Diameter of body, 2½".
Sectional area, 4.9 square inches.
Gauged length over thread, 12".43.
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
50,000	.06	.03	
75,000	.11	.04	
100,000	.14	.07	
123,100	.21	.13	
	.30	.....	
125,000	.31	.....	
145,000	.....	.....	Tensile strength=29,600 pounds per square inch on body of rod.

Fractured through the head in front of the pin hole.

Appearance, granular, radiating from the seamy spot at outside of the head.

Elongation on gauged length over thread, ".17.

Elongation on gauged length over head, ".08.

Elongation of pin hole, ".09.

Rod No. 2, with New Welded End.

Diameter of body, 2½".
Sectional area, 4.9 square inches.
Gauged length over thread, 12".
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load
50,000	.07	.01	
75,000	.10	.02	
100,000	.12	.14	
125,000	.18	.10	Set on gauged length over thread, ".03
126,000	.21	.13	Set on gauged length over thread, ".08.
150,000	.39	.30	Set on gauged length over thread, ".19.
160,000	.50	.....	
196,800	.....	.....	Tensile strength=40,000 pounds per square inch on body of rod.

Fractured through the head in front of the pin hole.
Appearance, granular.
Elongation on gauged length over thread, ".62.
Elongation on gauged length over head, ".16.
Elongation of pin hole, ".15.

Rod No. 3, with New Welded End.

Diameter of body, 2½".
Sectional area, 4.9 square inches.
Gauged length over thread, 12".
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
25,000	.05	.03	
50,000	.08	.04	
75,000	.10	.04	
100,000	.12	.05	
125,000	.14	.06	Set on gauged length over thread, ".01.
128,700	.16	.09	Set on gauged length over thread, ".04.
140,000	.26	.....	
150,000	.31	.22	Set on gauged length over thread, ".16.
160,000	.39	.....	
164,300	.....	.....	Tensile strength=33,500 pounds per square inch on body of rod.

Fractured through the head in front of the pin hole.
Appearance, granular, radiating from a seamy spot at the corner of the fractured surface, outside of head.
Elongation on gauged length over thread, ".24.
Elongation on gauged length over head, ".11.
Elongation of pin hole, ".13.

ROD NO. 4. OLD ROD WHICH HAD BEEN HEATED AT THREADED END.

Diameter of body, $2\frac{9}{16}$".
Sectional area, 5.15 square inches.
Gauged length over thread, 18".50.
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load
25,000	.07	.03	
50,000	.12	.05	
75,000	.15	.07	
100,000	.18	.08	
125,000	.21	.11	Set on gauged length over thread, ".02.
150,000	.25	.14	Set on gauged length over thread, ".03.
160,000	.28	.....	
162,000	.30	.19	Set on gauged length over thread, ".06.
175,000	.34	.23	Set on gauged length over thread, ".09.
200,000	.54	.41	Set on gauged length over thread, ".14.
225,000	.76	.....	
250,000	1.05	.....	
272,600	.....	.....	Tensile strength=52,900 pounds per square inch on body of rod.

Fractured through the head in front of pin hole.

Appearance, granular, seamy metal at corner at outside of the head. Opened cracks at root of thread immediately below the most worn part. These cracks presented dark-colored surfaces, and were evidently the development of incipient cracks which began when the rod was in the bridge, and discolored when the rod was subsequently heated in a smith's fire. The cracks were on opposite sides of the rod, about 30 degrees from a diameter parallel to the axis of the bridge.

Elongation on gauged length over thread, ".65.
Elongation on gauged length over head, ".35.
Elongation of pin hole, ".34.

ROD NO. 5. OLD ROD WHICH HAD BEEN HEATED AT THREADED END.

Diameter of body, 2½".
Sectional area, 4.9 square inches.
Gauged length over thread, 19".50.
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
50,000	.06	.02	
75,000	.08	.03	
100,000	.12	.05	
125,000	.16	.07	
150,000	.22	.12	Set on gauged length over thread, ".08.
160,000	.28	.....	
161,200	.29	.19	Set on gauged length over thread, ".07.
175,000	.34	.23	
200,000	.57	.44	Set on gauged length over thread, ".24.
225,000	.80	.....	
250,000	1.12	.....	
257,000	.....	.....	Tensile strength=52,400 pounds per square inch on body of rod.

Fractured in the threaded section, 12" from the end of the rod.

Appearance, granular, with dark-colored spots at the circumference, extending inward varying distances up to ⅛". Opened cracks at the root of the thread in the vicinity of the fracture, which were located at different places on the circumference of the rod, excepting the sides at right angles to the axis of the bridge, in which parts the cracks were seldom present. These cracks, like those in the rod No. 4, apparently represent progressive fractures which were in progress in the bridge, the surfaces of which were discolored when the rod was subsequently exposed to the heat of the smith's fire.

Elongation on gauged length over thread, ".69.
Elongation on gauged length over head, ".12.
Elongation of pin hole, ".12.

ROD NO. 6. OLD ROD WHICH HAD BEEN HEATED AT THREADED END.

Diameter of body, $2\frac{9}{16}$".
Sectional area, 5.15 square inches.
Gauged length over thread, 21".
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
25,000	.06	.02	
50,000	.10	.04	
75,000	.13	.05	
100,000	.15	.06	
125,000	.18	.08	Set on gauged length over thread, ".01.
150,000	.26	.16	Set on gauged length over thread, ".05.
160,000	.33	.....	
161,600	.34	.22	Set on gauged length over thread, ".10.
175,000	.41	.28	
200,000	.61	.47	Set on gauged length over thread, ".30.
225,000	.86	.....	
248,300	.....	.....	Tensile strength=48,200 pounds per square inch on body of rod.

Fractured 13".25 from end of rod.
Appearance, granular, with dark-colored spots at the circumference, penetrating varying distances up to ".15.
Elongation on gauged length over thread, ".74.
Elongation on gauged length over head, ".12.
Elongation of pin hole, ".13.

ROD NO. 7. OLD ROD WHICH HAD BEEN HEATED AT THREADED END.

Diameter of body, 2½".
Sectional area, 4.9 square inches.
Gauged length over thread, 21".
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load
25,000	.10	.04	
50,000	.14	.06	
75,000	.18	.07	
100,000	.21	.09	
125,000	.23	.10	
150,000	.28	.15	Set on gauged length over thread, 0".
175,000	.37	.24	Set on gauged length over thread, ".07.
195,400	.52	.37	Set on gauged length over thread, ".17.
200,000	.57	.41	Set on gauged length over thread, ".19.
225,000	.80	.....	
250,000	1.13	.92	Set on gauged length over thread, ".49.
318,600	.....	.....	Tensile strength = 65,000 pounds per square inch on body of rod.

Fractured 12" from the end of the rod, near the upper end and most reduced part of the worn section.
Appearance, granular. No cracks opened at the root of the thread.
Elongation on gauged length over thread, 2".05.
Elongation on gauged length over head, ".30.
Elongation of pin hole, ".35.

ROD NO. 8. OLD ROD WHICH HAD BEEN HEATED AT THREADED END.

Diameter of body, $2\frac{9}{16}$".
Sectional area, 5.15 square inches.
Gauged length over thread, 16".
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
25,000	.04	.02	
50,000	.07	.02	
75,000	.10	.03	
100,000	.12	.04	
125,000	.15	.05	Set on gauged length over thread, ".01.
150,000	.18	.08	Set on gauged length over thread, ".03.
175,000	.26	.15	Set on gauged length over thread, ".08.
186,300	.33	.21	Set on gauged length over thread, ".12.
200,000	.41	.28	Set on gauged length over thread, ".17.
225,000	.58	.....	
250,000	.81	.64	Set on gauged length over thread, ".42.
284,900	.....	.....	Tensile strength=55,300 pounds per square inch on body of rod.

Fractured 11".75 from end of rod.

Appearance, granular, radiating from a dark-colored spot at the circumference. Cracks with dark-colored surfaces developed at the roots of the threads in the vicinity of the fracture. These cracks were of the same description as those found in other rods. They were generally located in and near the plane of the diameter of the rod which was parallel to the axis of the bridge. There were no cracks opened in the threads at right angles to the axis of the bridge. It is understood in this connection that the axes of the pins through the heads of the rods occupied a position in the bridge at right angles to the direction of the length of the bridge. A number of these cracks were visible after 250,000 pounds tension had been applied to the rod.

Elongation on gauged length over thread, ".81.
Elongation on gauged length over head, ".15.
Elongation of pin hole, ".15.

Rod No. 10. New Rod.

Diameter of body, $2\frac{3}{4}$".
Sectional area, 5.94 square inches.
Gauged length over thread, 8".
Gauged length over head, 5".
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
25,000	.06	.03	
50,000	.10	.05	
75,000	.13	.06	
100,000	.16	.07	
125,000	.18	.08	
150,000	.21	.09	
175,000	.24	.10	
200,000	.27	.12	
225,000	.32	.15	Set on gauged length over thread, 0".
242,700	.36	.19	Set on gauged length over thread, ".02.
245,000	.39	.21	Set on gauged length over thread, ".02.
250,000	.41	.....	
275,000	.48	.28	Set on gauged length over thread, ".04.
300,000	.65	.43	Set on gauged length over thread, ".08.
325,000	.87	.61	Set on gauged length over thread, ".11.
375,000	1.27	.96	Set on gauged length over thread, ".18.
443,000	.....	.....	Tensile strength=74,600 pounds per square inch on body of rod.

Fractured at the thread, 7".75 from the end of the rod.
Appearance, granular.
Elongation on gauged length over thread, ".47.
Elongation on gauged length over head, ".46.
Elongation of pin hole, ".43.

ROD No. 11. NEW ROD

Diameter of body, 2¾″.
Sectional area, 5.94 square inches.
Gauged length over thread, 8″.
Gauged length over head, 5″.
The elongations tabulated below refer to measurements taken on the moving parts of the testing machine.

Applied loads.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
25,000	.05	02	
50,000	.08	.03	
75,000	.11	.04	
100,000	.13	.04	
125,000	.15	.05	
150,000	.17	.05	
175,000	.20	.06	
200,000	.23	.08	
225,000	.26	.10	
250,000	.30	.12	Set on gauged length over thread, ″0.
253,600	.33	.15	Set on gauged length over thread, ″.02.
256,000	.35	.17	Set on gauged length over thread, ″.03.
275,000	.40	.20	Set on gauged length over thread, ″.05.
300,000	.49	.29	Set on gauged length over thread, ″.08.
335,200	.....	.....	Tensile strength=56,400 pounds per square inch on body of rod.

Fractured in the head, across the pin hole.
Appearance, granular, radiating from the corner of the fractured surfaces.
Elongation on gauged length over thread, ″.12.
Elongation on gauged length over head, ″.19.
Elongation of pin hole, ″.17.

TENSILE TESTS OF SPECIMENS TURNED DOWN FROM BODIES OF SUSPENDER RODS, TAKEN OUT AFTER THE TESTS OF THE FULL-SIZED MEMBERS.

No. of rod.	Diameter.	Sectional area.	Tensile strength.		Elongation in 8″ or 6″		Contraction of area.	Elongation of inch sections.	Appearance of fractures.
			Total.	Per square inch.					
	Inches.	*Sq. in.*	*Pounds.*	*Pounds.*	*Inches.*	*Per cent.*	*Per cent.*		
5	1.129	1.00	82,300	82,300	1.06	17.5	43.3	″.06, ″.08, ″.10, ″.18, ″.47*, ″.17	Fibrous, cup shaped.
6	1.129	1.00	83,300	83,300	1.00	16.7	40.6	″.04, ″.06, ″.10, ″.17, ″.45*, ″.18	Do.
7	1.129	1.00	85,800	85,800	.60	10.0	47.2	″.00, ″.00, ″.01, ″.02, ″.17, ″.40*	Do.
8	1.129	1.00	83,400	83,400	1.26	21.0	49.7	″.09, ″.13, ″.19, ″.54*, ″.20, ″.11	Do.
9	.564	.25	18,790	75,160	.89	29.7	59.3	″.18, ″.52*, ″.19	Fine silky, cup shaped.

A bending test was made on the short bar No. 9, diameter of body $1\frac{9}{16}$″, prior to taking out the tensile specimen from one end of the same. The bar bent 160 degrees and then fractured in the threaded section with a granular appearance.

REMARKS.—The new threaded ends of rods Nos. 1, 2, and 3 were welded on, and the heating of rods Nos. 4 to 8 over their threaded sections was done prior to their being received for testing.

NO. 1.

APPEARANCE OF OLD RODS WITH NEW WELDED ENDS, SHOWING LOCATION OF FRACTURES MADE IN THE TESTING MACHINE

NO. 2

APPEARANCE OF OLD BOLTS WHICH BROKE AT THE FRACTURE
MADE IN THE TESTING MACHINE.

NO. 3.

APPEARANCE OF NEW RODS, SHOWING LOCATION OF FRACTURES MADE IN THE TESTING MACHINE.

NO. 4.

ROD 1. ROD 2. ROD 3.

FRACTURES IN HEADS OF WELDED RODS, MADE DURING TESTING.

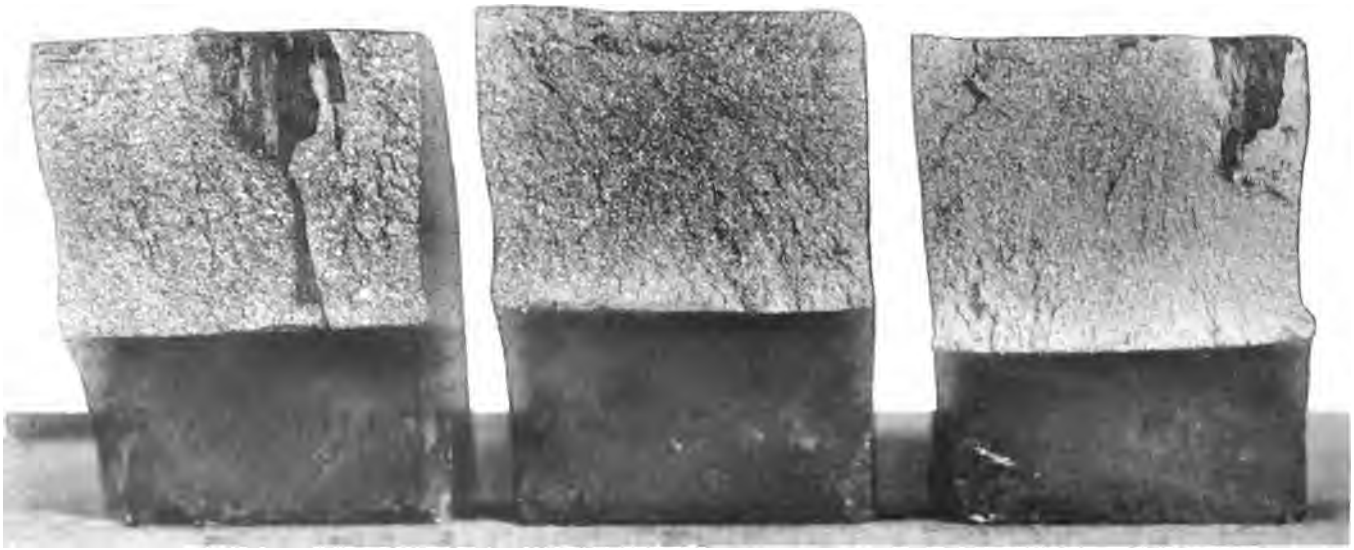
HELIOTYPE CO., BOSTON.

ROD 4. ROD 5. ROD 6. ROD 7. ROD 8.

NO. 5.

VIEW SHOWING ELONGATION OF PIN HOLES IN HEADS OF RODS, AND FRACTURE OF ROD NO. 4, AFTER TESTING.

HE. 'TYPE CO., BOSTON.



NO. 6.

ROD 1. ROD 2. ROD 3.

APPEARANCE OF THE FRACTURED SURFACES IN THE HEADS OF RODS NOS. 1, 2 AND 3.

HELIOTYPE CO., BOSTON

NO. 7.

FRACTURED SURFACE OF ROD NO. 5, MADE DURING TESTING.
THE DARK SPOTS AT THE CIRCUMFERENCE, BELOW THE THREAD, SHOW INCIPIENT CRACKS EXISTING IN THE ROD BEFORE TESTING.

HELIOTYPE CO., BOSTON

NO. 8.

FRACTURED SURFACE OF ROD NO. 6, MADE DURING TESTING.
THE DARK SPOTS AT THE CIRCUMFERENCE, BELOW THE THREAD, SHOW INCIPIENT CRACKS EXISTING IN THE ROD BEFORE TESTING.

HELIOTYPE CO., BOSTON.

NO. 9.

FRACTURED SURFACE OF ROD NO. 8, MADE DURING TESTING.
THE DARK SPOTS AT THE CIRCUMFERENCE, BELOW THE THREAD, SHOW INCIPIENT CRACKS EXISTING IN THE ROD BEFORE TESTING.

HELIOTYPE CO., BOSTON.

NO. 10.

THREADED PART OF ROD NO. 5, SHOWING INCIPIENT CRACKS AT ROOT OF THREADS, WHICH EXISTED IN THE ROD BEFORE TESTING.

HELIOTYPE CO., BOSTON.

NO. 11.

THREADED PART OF ROD NO. 6, SHOWING INCIPIENT CRACKS AT ROOT OF THREADS, WHICH EXISTED IN THE ROD BEFORE TESTING.

HELIOTYPE CO., BOSTON.

NO. 12.

THREADED PART OF ROD NO. 8, SHOWING INCIPIENT CRACKS AT ROOT OF THREADS, WHICH EXISTED IN THE ROD BEFORE TESTING.

HELIOTYPE CO., BOSTON.

NO. 13.

ROD NO. 8, SHOWING INCIPIENT CRACKS AT THE ROOT OF THE THREADS.

HE [illegible] CO., BOSTON.

ENDURANCE OF ROTATING SHAFTS.

ENDURANCE OF ROTATING SHAFTS.

DETAILS OF TESTS.

No. 300. Marks, 9–C1.

Turned down from bar 1¼″ diameter; 0.82 per cent carbon. Hot rolled bar.

Diameter, 1″. Speed of rotation, 1,800 and 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
30,000	0	0	a	.2005	.1765	.2005	.0240	0.	
	.....	.....	b	.2002	.1763	.2002	.0239	0.	
	.....	.....	c	.2003	.1767	.2002	.0235	.0001	
	49,477,300	49,477,300	.....	.....	.....	.....	.....	.....	Bar rested without load an interval of 6 years 7 months, at the end of which rest the test was resumed, the speed of rotation now being 500 per minute, other conditions of the test as before.
	0	49,477,300	a	.1653	.1408	.1653	.0245	0.	
	.....	.....	b	.1649	.1405	.1649	.0244	0.	
	.....	.....	c	.1650	.1405	.1649	.0244	.0001	
	1,000	49,478,300	a	.1652	.1406	.1652	.0246	0.	
	.....	.....	b	.1649	.1408	.1649	.0246	0.	
	.....	.....	c	.1649	.1406	.1649	.0243	0.	
	9,000	49,487,300	a	.1652	.1409	.1652	.0243	0.	
	.....	.....	b	.1649	.1407	.1649	.0242	0.	
	.....	.....	c	.1649	.1407	.1649	.0242	0.	
35,000	0	49,487,300	a	.1652	.1368	.1651	.0283	.0001	
	.....	.....	b	.1649	.1360	.1649	.0289	0.	
	.....	.....	c	.1649	.1360	.1649	.0289	0.	
	1,000	49,488,300	a	.1652	.1366	.1652	.0286	0.	
	.....	.....	b	.1649	.1362	.1649	.0287	0.	
	.....	.....	c	.1649	.1365	.1649	.0284	0.	
	9,000	49,497,300	a	.1652	.1365	.1652	.0287	0.	
	.....	.....	b	.1649	.1363	.1649	.0286	0.	
	.....	.....	c	.1649	.1362	.1649	.0287	0.	
40,000	0	49,497,300	a	.1652	.1324	.1652	.0328	0.	
	.....	.....	b	.1649	.1324	.1649	.0325	0.	
	.....	.....	c	.1649	.1323	.1649	.0326	0.	
	1,000	49,498,300	a	.1652	.1326	.1651	.0325	.0001	
	.....	.....	b	.1649	.1324	.1648	.0324	.0001	
	.....	.....	c	.1650	.1322	.1649	.0327	.0001	
	9,000	49,507,300	a	.1653	.1325	.1651	.0326	.0002	
	.....	.....	b	.1649	.1320	.1648	.0328	.0001	
	.....	.....	c	.1650	.1324	.1648	.0324	.0002	
45,000	0	49,507,300	a	.1654	.1282	.1651	.0369	.0003	
	.....	.....	b	.1650	.1278	.1647	.0374	.0003	
	.....	.....	c	.1652	.1277	.1647	.0370	.0005	
	1,000	49,508,300	a	.1652	.1277	.1648	.0371	.0004	
	.....	.....	b	.1652	.1281	.1647	.0366	.0005	
	.....	.....	c	.1652	.1277	.1645	.0368	.0007	
	9,000	49,517,300	a	.1653	.1270	.1645	.0375	.0008	
	.....	.....	b	.1655	.1274	.1644	.0370	.0011	
	.....	.....	c	.1654	.1270	.1643	.0373	.0011	
	123,840	49,641,140	.....	.....	.....	.....	.....	.....	Bar ruptured at the south edge of north middle bearing.

No. 301. Marks, 7 B 17 Y1—1.

Turned down from bar 1¼″ diameter; 0.32 per cent carbon; 1.20 manganese.

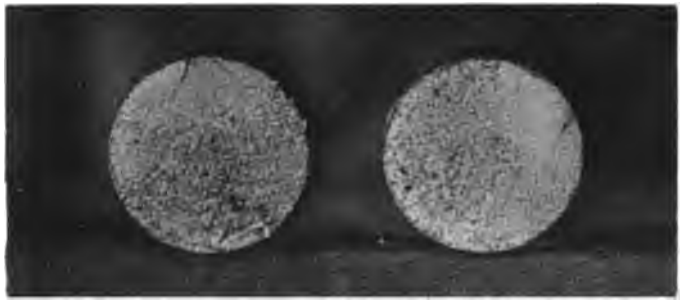
Diameter, 1″. Speed of rotation, 750 and 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflection measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.2008	.1690	.2008	.0318	0.	
	.....	.....	b	.2006	.1688	.2006	.0318	0.	
	.....	.....	c	.2012	.1694	.2012	.0318	0.	
	10,000	10,000	a	.2008	.1688	.2008	.0320	0.	
	.....	.....	b	.2006	.1686	.2006	.0320	0.	
	.....	.....	c	.2012	.1691	.2011	.0320	.0001	
	90,000	100,000	a	.2006	.1680	.2006	.0326	0.	Bar warm, about 150° F.
	.....	.....	b	.2005	.1680	.2005	.0325	0.	
	.....	.....	c	.2012	.1685	.2012	.0327	0.	
	0	100,000	a	.2008	.1688	.2008	.0320	0.	Measurements repeated after bar was cold.
	.....	.....	b	.2007	.1685	.2007	.0322	0.	
	.....	.....	c	.2011	.1691	.2011	.0320	0.	
	80,018,000	80,118,000	.....	.....	.....	.....	.....	.....	Bar rested without load an interval of 4 years 3 months, at the end of which rest the test was resumed, the speed of rotation now being 500 per minute, other conditions of the test as before.
	0	80,118,000	a	.1655	.1335	.1655	.0320	0.	
	.....	.....	b	.1653	.1331	.1653	.0322	0.	
	.....	.....	c	.1659	.1342	.1659	.0317	0.	
	1,000	80,119,000	a	.1654	.1326	.1654	.0328	0.	
	.....	.....	b	.1652	.1327	.1652	.0325	0.	
	.....	.....	c	.1659	.1340	.1658	.0318	.0001	
45,000	0	80,119,000	a	.1655	.1298	.1655	.0357	0.	
	.....	.....	b	.1654	.1287	.1653	.0366	.0001	
	.....	.....	c	.1659	.1296	.1659	.0363	0.	
	1,000	80,120,000	a	.1654	.1292	.1654	.0362	0.	
	.....	.....	b	.1653	.1290	.1653	.0363	0.	
	.....	.....	c	.1659	.1295	.1659	.0364	0.	
	9,000	80,129,000	a	.1655	.1289	.1654	.0365	.0001	
	.....	.....	b	.1653	.1290	.1652	.0362	.0001	
	.....	.....	c	.1658	.1294	.1658	.0364	0.	
	6,489,000	86,618,000	a	.1639	.1275	.1639	.0364	0.	
	.....	.....	b	.1635	.1278	.1635	.0357	0.	
	.....	.....	c	.1642	.1283	.1641	.0358	.0001	
50,000	0	86,618,000	a	.1638	.1239	.1638	.0399	0.	
	.....	.....	b	.1636	.1236	.1635	.0399	.0001	
	.....	.....	c	.1643	.1244	.1643	.0399	0.	
	1,000	86,619,000	a	.1638	.1234	.1638	.0404	0.	
	.....	.....	b	.1635	.1233	.1635	.0402	0.	
	.....	.....	c	.1643	.1241	.1642	.0401	.0001	
	9,000	86,628,000	a	.1638	.1237	.1638	.0401	0.	
	.....	.....	b	.1636	.1233	.1635	.0402	.0001	
	.....	.....	c	.1643	.1241	.1641	.0400	.0002	



NO 300.

NO. 301.

FRACTURED ENDS OF ENDURANCE SHAFTS.

HELIOTYPE CO., BOSTON.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
	7,983,490	94,611,490	a	.1645	.1237	.1644	.0407	.0001	
	.....	.....	b	.1640	.1234	.1640	.0406	0.	
	.....	.....	c	.1638	.1237	.1638	.0401	0.	
55,000	0	94,611,490	a	.1644	.1198	.1644	.0446	0.	
	.....	.....	b	.1641	.1200	.1640	.0440	.0001	
	.....	.....	c	.1639	.1199	.1639	.0440	0.	
	1,000	94,612,490	a	.1643	.1205	.1643	.0438	0.	
	.....	.....	b	.1641	.1201	.1640	.0439	.0001	
	.....	.....	c	.1639	.1200	.1638	.0438	.0001	
	9,000	94,621,490	a	.1644	.1207	.1645	.0438	−.0001	
	.....	.....	b	.1641	.1205	.1640	.0435	.0001	
	.....	.....	c	.1639	.1203	.1638	.0435	.0001	
	100,000	94,721,490	a	.1644	.1203	.1644	.0441	0.	
	.....	.....	b	.1640	.1201	.1640	.0439	0.	
	.....	.....	c	.1640	.1200	.1638	.0438	.0002	
	797,520	95,519,010	.....	.....	.....	.....	.....	.....	Bar ruptured ".50 south of south edge of south middle bearing.

No. 308. Marks, 11-C 3.

Turned down from bar 1¼″ diameter; 1.09 per cent carbon. Hot rolled bar.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1270	.0949	.1269	.0320	.0001	
	.....	.....	b	.1273	.0949	.1272	.0323	.0001	
	.....	.....	c	.1272	.0945	.1272	.0327	0.	
	1,000	1,000	a	.1270	.0942	.1269	.0327	.0001	
	.....	.....	b	.1273	.0941	.1271	.0330	.0002	
	.....	.....	c	.1273	.0939	.1271	.0332	.0002	
	9,000	10,000	a	.1270	.0935	.1267	.0332	.0003	
	.....	.....	b	.1273	.0939	.1271	.0332	.0002	
	.....	.....	c	.1270	.0936	.1268	.0332	.0002	
	177,200	187,200	a	.1330	.0987	.1325	.0338	.0005	
	.....	.....	b	.1340	.0991	.1329	.0338	.0011	
	.....	.....	c	.1335	.0989	.1325	.0336	.0010	
	859,600	1,046,800	a	.1375	.1036	.1375	.0339	0.	
	.....	.....	b	.1393	.1039	.1381	.0342	.0012	
	.....	.....	c	.1398	.1041	.1382	.0341	.0016	

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	—
	9,631,350	10,678,150	a	.1455	.1108	.1448	.0340	.0007	
	.....	.....	b	.1458	.1110	.1451	.0341	.0007	
	.....	.....	c	.1462	.1111	.1451	.0340	.0011	
	42,315,060	52,993,210	a	.1554	.1219	.1546	.0327	.0008	
	.....	.....	b	.1555	.1219	.1549	.0330	.0006	
	.....	.....	c	.1555	.1220	.1549	.0329	.0006	
	47,969,090	100,962,300	a	.1555	.1228	.1553	.0325	.0002	
	.....	.....	b	.1555	.1227	.1553	.0326	.0002	
	.....	.....	c	.1557	.1228	.1554	.0326	.0003	
	28,626,650	129,588,950	a	.1556	.1224	.1553	.0329	.0003	
	.....	.....	b	.1555	.1223	.1553	.0330	.0002	
	.....	.....	c	.1556	.1224	.1554	.0330	.0002	
	767,310	130,356,260	.....	.....	.....	.....	.....	.....	Bar rested without load an interval of 10 months, at the end of which rest the test was resumed, under same conditions as before.
	0	130,356,260	a	.1656	.1325	.1656	.0331	0.	
	.....	.....	b	.1656	.1327	.1655	.0328	.0001	
	.....	.....	c	.1659	.1328	.1657	.0329	.0002	
	1,000	130,357,260	a	.1658	.1326	.1656	.0330	.0002	
	.....	.....	b	.1656	.1326	.1655	.0329	.0001	
	.....	.....	c	.1659	.1329	.1657	.0328	.0002	
	10,000	130,367,260	a	.1656	.1328	.1655	.0327	.0001	
	.....	.....	b	.1657	.1330	.1656	.0325	.0002	
	.....	.....	c	.1659	.1329	.1657	.0328	.0002	
	132,740	130,500,000	.....	.....	.....	.....	.....	.....	
45,000	0	130,500,000	a	.1654	.1287	.1654	.0367	0.	
	.....	.....	b	.1655	.1285	.1654	.0369	.0001	
	.....	.....	c	.1657	.1291	.1656	.0365	.0001	
	1,000	130,501,000	a	.1656	.1281	.1654	.0373	.0002	
	.....	.....	b	.1659	.1286	.1655	.0369	.0004	
	.....	.....	c	.1659	.1283	.1656	.0373	.0008	
	10,000	130,511,000	a	.1658	.1277	.1652	.0375	.0006	
	.....	.....	b	.1660	.1287	.1655	.0368	.0005	
	.....	.....	c	.1660	.1285	.1655	.0370	.0005	
	904,010	131,415,010	a	.1659	.1253	.1643	.0390	.0016	
	.....	.....	b	.1677	.1260	.1645	.0385	.0032	
	.....	.....	c	.1667	.1256	.1642	.0386	.0025	
	102,290	131,517,300	.....	.....	.....	.....	.....	.....	Bar ruptured ".10 south of the south edge of the north middle bearing.

NO. 308.

NO, 309.

FRACTURED ENDS OF ENDURANCE SHAFTS.

HELIOTYPE CO., BOSTON.

No. 309. Marks, 7–B1.

Turned down from bar 1¼″ diameter; 0.73 per cent carbon. Hot rolled bar.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1320	.0994	.1320	.0326	0.	
			b	.1319	.0991	.1318	.0327	.0001	
			c	.1318	.0991	.1318	.0327	0.	
	1,000	1,000	a	.1320	.0995	.1320	.0325	0.	
			b	.1318	.0991	.1318	.0327	0.	
			c	.1317	.0992	.1317	.0325	0.	
	9,000	10,000	a	.1319	.0995	.1319	.0324	0.	
			b	.1318	.0994	.1317	.0323	.0001	
			c	.1318	.0992	.1318	.0326	0.	
	84,700	94,700	a	.1329	.1001	.1328	.0327	.0001	
			b	.1328	.1003	.1327	.0324	.0001	
			c	.1329	.1000	.1327	.0327	.0002	
	924,000	1,018,700	a	.1376	.1049	.1376	.0327	0.	
			b	.1375	.1049	.1374	.0325	.0001	
			c	.1374	.1048	.1374	.0326	0.	
	9,408,510	10,427,210	a	.1445	.1118	.1444	.0326	.0001	
			b	.1444	.1116	.1443	.0327	.0001	
			c	.1443	.1116	.1443	.0327	0.	
	41,274,760	51,701,970	a	.1542	.1217	.1542	.0325	0.	
			b	.1541	.1214	.1540	.0326	.0001	
			c	.1540	.1213	.1540	.0327	0.	
	51,565,330	103,267,300	a	.1549	.1216	.1548	.0332	.0001	
			b	.1546	.1215	.1546	.0331	0.	
			c	.1546	.1212	.1545	.0333	.0001	
	46,567,860	149,835,160	.....	.....	.....	.....	.....	.....	Bar rested without load an interval of 10 months, at the end of which rest the test was resumed, under same conditions as before.
	11,370	149,846,530	a	.1644	.1322	.1644	.0322	0.	
			b	.1643	.1321	.1642	.0321	.0001	
			c	.1642	.1320	.1642	.0322	0.	
	153,470	150,000,000	.....	.....	.....	.....	.....	.....	
45,000	0	150,000,000	a	.1647	.1280	.1645	.0365	.0002	
			b	.1644	.1282	.1643	.0361	.0001	
			c	.1644	.1283	.1643	.0360	.0001	
	1,000	150,001,000	a	.1646	.1288	.1645	.0357	.0001	
			b	.1644	.1283	.1643	.0360	.0001	
			c	.1644	.1280	.1643	.0363	.0001	
	10,000	150,011,000	a	.1646	.1285	.1645	.0360	.0001	
			b	.1645	.1283	.1643	.0360	.0002	
			c	.1644	.1282	.1642	.0360	.0002	
	9,489,000	159,500,000	a	.1629	.1264	.1629	.0365	0.	
			b	.1629	.1259	.1626	.0367	.0003	
			c	.1628	.1259	.1625	.0366	.0003	

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
50,000	0	159,500,000	a	.1633	.1225	.1630	.0405	.0003	
	.....	.....	b	.1630	.1220	.1627	.0407	.0003	
	.....	.....	c	.1629	.1221	.1626	.0405	.0003	
	1,000	159,501,000	a	.1630	.1222	.1630	.0408	0.	
	.....	.....	b	.1630	.1217	.1627	.0410	.0003	
	.....	.....	c	.1629	.1218	.1626	.0408	.0003	
	9,000	159,510,000	a	.1635	.1224	.1630	.0406	.0005	
	.....	.....	b	.1630	.1219	.1627	.0408	.0003	
	.....	.....	c	.1630	.1218	.1625	.0407	.0005	
	344,050	159,854,050	.....	.....	.....	.....	.....	.....	Bar ruptured midway the north and south middle bearings.

No. 310. Marks, 9–C 2.

Turned down from bar 1¼″ diameter; 0.82 per cent carbon. Hot rolled bar.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

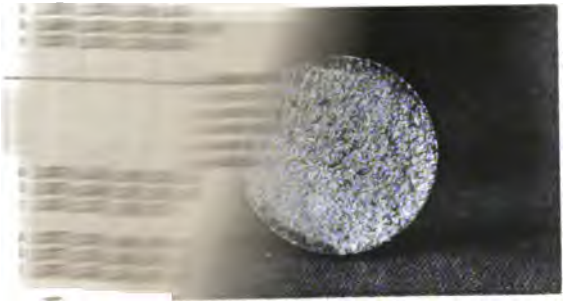
Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1346	.1018	.1345	.0327	.0001	
	.....	.....	b	.1346	.1016	.1345	.0329	.0001	
	.....	.....	c	.1343	.1015	.1343	.0328	0.	
	1,000	1,000	a	.1345	.1020	.1345	.0325	0.	
	.....	.....	b	.1346	.1016	.1345	.0329	.0001	
	.....	.....	c	.1345	.1014	.1344	.0330	.0001	
	9,000	10,000	a	.1345	.1009	.1344	.0335	.0001	
	.....	.....	b	.1345	.1016	.1344	.0328	.0001	
	.....	.....	c	.1344	.1010	.1341	.0331	.0003	
	189,500	199,500	a	.1359	.1020	.1355	.0335	.0004	
	.....	.....	b	.1356	.1024	.1353	.0329	.0002	
	.....	.....	c	.1352	.1018	.1350	.0332	.0002	
	908,000	1,107,500	a	.1412	.1077	.1412	.0335	0.	
	.....	.....	b	.1416	.1076	.1413	.0337	.0003	
	.....	.....	c	.1413	.1075	.1410	.0335	.0003	
	10,640,600	11,748,100	a	.1477	.1143	.1474	.0331	.0003	
	.....	.....	b	.1476	.1145	.1474	.0329	.0002	
	.....	.....	c	.1475	.1145	.1472	.0327	.0003	
	39,087,820	50,785,920	a	.1575	.1242	.1573	.0331	.0002	
	.....	.....	b	.1575	.1244	.1574	.0330	.0001	
	.....	.....	c	.1572	.1242	.1570	.0328	.0002	

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
	51,314,240	102,100,160	a	.1579	.1249	.1578	.0329	.0001	
	.....	.....	b	.1577	.1248	.1577	.0329	0.	
	.....	.....	c	.1575	.1244	.1574	.0330	.0001	
	49,169,090	151,269,250	a	.1580	.1250	.1580	.0330	0.	
	.....	.....	b	.1580	.1246	.1579	.0333	.0001	
	.....	.....	c	.1576	.1246	.1576	.0330	0.	
	754,110	152,023,360	.....	.....	.....	.....	.....	.....	Bar rested without load an interval of 10 months, at the end of which rest the test was resumed, under same conditions as before.
	2,090	152,025,450	a	.1679	.1361	.1678	.0317	.0001	
	.....	.....	b	.1678	.1360	.1677	.0317	.0001	
	.....	.....	c	.1674	.1357	.1674	.0317	0.	
	1,000	152,026,450	a	.1677	.1357	.1676	.0319	.0001	
	.....	.....	b	.1677	.1357	.1676	.0319	.0001	
	.....	.....	c	.1675	.1355	.1674	.0319	.0001	
	10,000	152,036,450	a	.1678	.1358	.1677	.0319	.0001	
	.....	.....	b	.1677	.1358	.1676	.0318	.0001	
	.....	.....	c	.1675	.1356	.1674	.0318	.0001	
	464,270	152,500,720	.....	.....	.....	.....	.....	.....	
45,000	0	152,500,720	a	.1678	.1324	.1678	.0354	0.	
	.....	.....	b	.1678	.1324	.1677	.0353	.0001	
	.....	.....	c	.1676	.1320	.1675	.0355	.0001	
	1,000	152,501,720	a	.1679	.1322	.1678	.0356	.0001	
	.....	.....	b	.1678	.1322	.1677	.0355	.0001	
	.....	.....	c	.1675	.1320	.1675	.0355	0.	
	10,010	152,511,730	a	.1679	.1322	.1678	.0356	.0001	
	.....	.....	b	.1678	.1322	.1677	.0355	.0001	
	.....	.....	c	.1677	.1319	.1675	.0356	.0002	
	928,280	153,440,010	a	.1684	.1304	.1673	.0369	.0011	
	.....	.....	b	.1681	.1304	.1672	.0368	.0009	
	.....	.....	c	.1679	.1302	.1669	.0367	.0010	
	47,530	153,487,540	a	.1683	.1309	.1673	.0364	.0010	
	.....	.....	b	.1683	.1309	.1673	.0364	.0010	
	.....	.....	c	.1679	.1305	.1670	.0365	.0009	
	784,440	154,271,980	.....	.....	.....	.....	.....	.....	Bar ruptured 1.″10 south of the south edge of north middle bearing.

No. 321. Marks, 7 × 2, 1.
Turned down from bar 1¼″ diameter. 0.25 per cent carbon. Annealed at low heat.
Diameter, 1″. Speed of rotation, 500 per minute
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch	Number of rotations. Successive.	Number of rotations. Total.	Micrometer readings for deflections. On line.	Unloaded.	Loaded.	Unloaded.	Deflections.	Sets.	Remarks.
				Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
[illegible]	0	0	a	.1558	.1229	.1557	.0328	.0001	
			b	.1547	.1218	.1546	.0328	.0001	
			c	.1568	.1234	.1566	.0332	.0002	
	1,000	1,000	a	.1557	.1222	.1556	.0334	.0001	
			b	.1547	.1210	.1545	.0335	.0002	
			c	.1568	.1229	.1566	.0337	.0002	
	9,000	10,000	a	.1558	.1224	.1557	.0333	.0001	
			b	.1544	.1208	.1543	.0335	.0001	
			c	.1568	.1235	.1568	.0333	0.	
	8,168,160	8,178,160	a	.1559	.1229	.1557	.0328	.0002	
			b	.1546	.1216	.1545	.0329	.0001	
			c	.1570	.1239	.1568	.0329	.0002	
	13,096,740	21,274,900	a	.1559	.1230	.1559	.0329	0.	
			b	.1547	.1218	.1546	.0328	.0001	
			c	.1569	.1238	.1569	.0331	0.	
	22,901,830	44,176,730	a	.1560	.1227	.1560	.0333	0.	
			b	.1546	.1214	.1546	.0332	0.	
			c	.1571	.1235	.1570	.0335	.0001	
	754,100	44,930,830							Bar rested without load an interval of 10 months, at the end of which rest the test was resumed, under same conditions as before.
	150	44,930,980	a	.1664	.1334	.1664	.0330	0.	
			b	.1648	.1316	.1647	.0331	.0001	
			c	.1674	.1348	.1674	.0326	0.	
	69,020	45,000,000							
45,000	0	45,000,000	a	.1665	.1294	.1664	.0370	.0001	
			b	.1649	.1277	.1647	.0670	.0002	
			c	.1674	.1305	.1674	.0369	0.	
	1,000	45,001,000	a	.1665	.1294	.1664	.0370	.0001	
			b	.1649	.1283	.1648	.0365	.0001	
			c	.1675	.1304	.1674	.0370	.0001	
	899,790	45,900,790	a	.1661	.1285	.1661	.0376	0.	
			b	.1649	.1269	.1648	.0379	.0001	
			c	.1676	.1299	.1673	.0374	.0003	
		)							Bar ruptured ″.08 south of the north edge of north middle bearing.

Maximum fiber stress per square inch.	Number of [illegible]	
	Successive.	Ten[illegible]
Pounds		
	[illegible]	
	[illegible]	
	[illegible]	
	[illegible]	
	[illegible]	
	[illegible]	
	[illegible]	
	[illegible]	
	[illegible]	
45,000	[illegible]	



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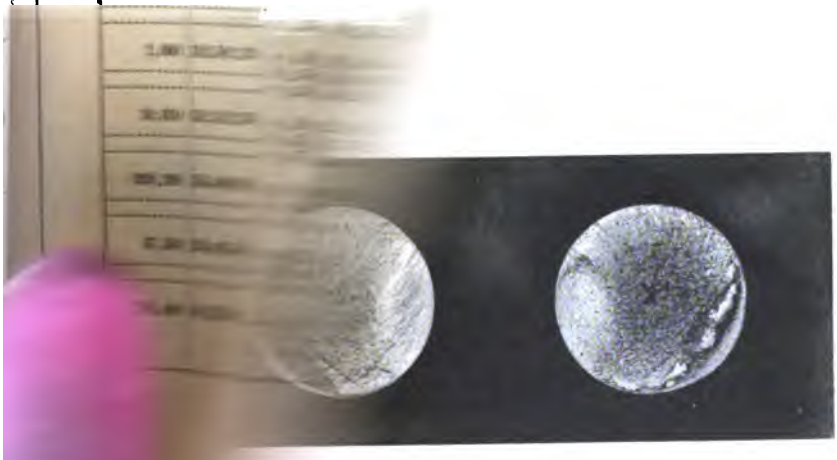


NO. 321.

FRACTURED ENDS OF ENDURANCE SHAFTS.

[illegible] BOSTON.

No. 321. Marks, 7 × 2, 1.

Turned down from bar 1¼″ diameter. 0.25 per cent carbon. Annealed at low heat.

Diameter, 1″. Speed of rotation, 500 per minute

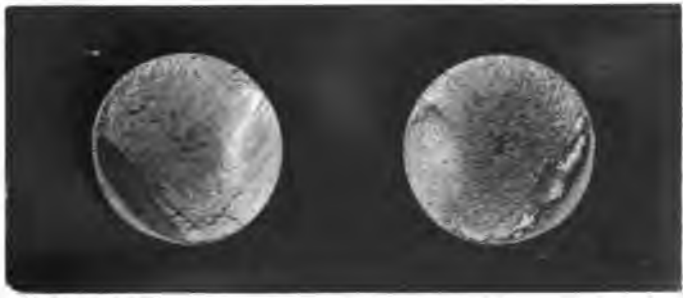
Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
40,000	0	0	a	.1558	.1229	.1557	.0328	.0001	
	.....	.....	b	.1547	.1218	.1546	.0328	.0001	
	.....	.....	c	.1568	.1234	.1566	.0332	.0002	
	1,000	1,000	a	.1557	.1222	.1556	.0334	.0001	
	.....	.....	b	.1547	.1210	.1545	.0335	.0002	
	.....	.....	c	.1568	.1229	.1566	.0337	.0002	
	9,000	10,000	a	.1558	.1224	.1557	.0333	.0001	
	.....	.....	b	.1544	.1208	.1543	.0335	.0001	
	.....	.....	c	.1568	.1235	.1568	.0333	0.	
	3,168,160	3,178,160	a	.1559	.1229	.1557	.0328	.0002	
	.....	.....	b	.1546	.1216	.1545	.0329	.0001	
	.....	.....	c	.1570	.1239	.1568	.0329	.0002	
	18,096,740	21,274,900	a	.1559	.1230	.1559	.0329	0.	
	.....	.....	b	.1547	.1218	.1546	.0328	.0001	
	.....	.....	c	.1569	.1238	.1569	.0331	0.	
	22,901,830	44,176,730	a	.1560	.1227	.1560	.0333	0.	
	.....	.....	b	.1546	.1214	.1546	.0332	0.	
	.....	.....	c	.1571	.1235	.1570	.0335	.0001	
	754,100	44,930,830	.....	.....	.....	.....	.....	.....	Bar rested without load an interval of 10 months, at the end of which rest the test was resumed, under same conditions as before.
	150	44,930,980	a	.1664	.1334	.1664	.0330	0.	
	.....	.....	b	.1648	.1316	.1647	.0331	.0001	
	.....	.....	c	.1674	.1348	.1674	.0326	0.	
	69,020	45,000,000	.....	.....	.....	.....	.....	.....	
45,000	0	45,000,000	a	.1665	.1294	.1664	.0370	.0001	
	.....	.....	b	.1649	.1277	.1647	.0370	.0002	
	.....	.....	c	.1674	.1305	.1674	.0369	0.	
	1,000	45,001,000	a	.1665	.1294	.1664	.0370	.0001	
	.....	.....	b	.1649	.1283	.1648	.0365	.0001	
	.....	.....	c	.1675	.1304	.1674	.0370	.0001	
	899,790	45,900,790	a	.1661	.1285	.1661	.0376	0.	
	.....	.....	b	.1649	.1269	.1648	.0379	.0001	
	.....	.....	c	.1676	.1299	.1673	.0374	.0003	
	21,850	45,922,640	.....	.....	.....	.....	.....	.....	Bar ruptured ″.08 south of the north edge of north middle bearing.

NO. 310.



NO. 321.

FRACTURED ENDS OF ENDURANCE SHAFTS.

HELIOTYPE CO., BOSTON.

No. 322. Marks, N 3–E.

0.17 per cent carbon; 3.25 per cent nickel. Metal in natural state of the ingot.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
10,000	0	0	a	.1663	.1579	.1663	.0084	0.	
	.....	.....	b	.1661	.1577	.1661	.0084	0.	
	.....	.....	c	.1661	.1578	.1661	.0083	0.	
	1,000	1,000	a	.1662	.1578	.1662	.0084	0.	
	.....	.....	b	.1661	.1577	.1661	.0084	0.	
	.....	.....	c	.1661	.1578	.1561	.0083	0.	
	9,000	10,000	a	.1662	.1578	.1662	.0084	0.	
	.....	.....	b	.1661	.1577	.1661	.0084	0.	
	.....	.....	c	.1661	.1578	.1661	.0083	0.	
15,000	0	10,000	a	.1662	.1537	.1662	.0125	0.	
	.....	.....	b	.1661	.1537	.1661	.0124	0.	
	.....	.....	c	.1661	.1536	.1661	.0125	0.	
	1,000	11,000	a	.1662	.1537	.1662	.0125	0.	
	.....	.....	b	.1661	.1535	.1661	.0126	0.	
	.....	.....	c	.1661	.1536	.1661	.0125	0.	
	10,000	21,000	a	.1662	.1535	.1662	.0127	0.	
	.....	.....	b	.1661	.1535	.1661	.0126	0.	
	.....	.....	c	.1661	.1535	.1661	.0126	0.	
20,000	0	21,000	a	.1662	.1498	.1662	.0164	0.	
	.....	.....	b	.1661	.1495	.1661	.0166	0.	
	.....	.....	c	.1661	.1495	.1661	.0166	0.	
	1,000	22,000	a	.1662	.1495	.1662	.0167	0.	
	.....	.....	b	.1661	.1495	.1661	.0166	0.	
	.....	.....	c	.1661	.1495	.1661	.0166	0.	
	10,000	32,000	a	.1662	.1495	.1662	.0167	0.	
	.....	.....	b	.1661	.1494	.1661	.0167	0.	
	.....	.....	c	.1661	.1495	.1661	.0166	0.	
25,000	0	32,000	a	.1662	.1455	.1662	.0207	0.	
	.....	.....	b	.1661	.1450	.1661	.0211	0.	
	.....	.....	c	.1661	.1450	.1661	.0211	0.	
	1,000	33,000	a	.1660	.1450	.1659	.0209	.0001	
	.....	.....	b	.1662	.1450	.1661	.0211	.0001	
	.....	.....	c	.1662	.1450	.1661	.0211	.0001	
	10,000	43,000	a	.1660	.1447	.1660	.0213	0.	
	.....	.....	b	.1662	.1449	.1661	.0212	.0001	
	.....	.....	c	.1662	.1450	.1661	.0211	.0001	
30,000	0	43,000	a	.1663	.1406	.1660	.0254	.0003	
	.....	.....	b	.1664	.1410	.1660	.0250	.0004	
	.....	.....	c	.1664	.1406	.1660	.0254	.0004	
	1,000	44,000	a	.1660	.1410	.1657	.0247	.0003	
	.....	.....	b	.1665	.1407	.1660	.0258	.0005	
	.....	.....	c	.1664	.1407	.1660	.0253	.0004	
	10,000	54,000	a	.1664	.1409	.1659	.0250	.0005	
	.....	.....	b	.1662	.1405	.1658	.0253	.0004	
	.....	.....	c	.1663	.1409	.1660	.0251	.0003	
	74,840	128,840	.....	.....	.....	.....	.....	.....	Bar ruptured 1″.25 north of the north edge of south middle bearing.

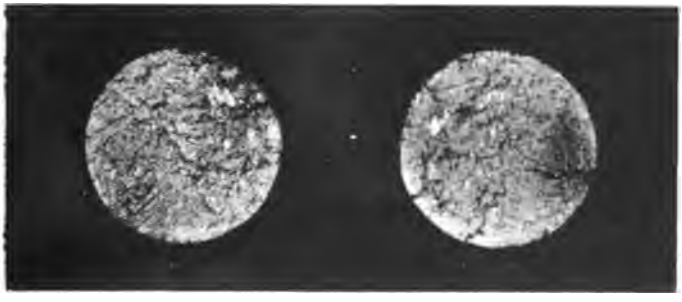
No. 323. Marks, C 3–E.
0.20 per cent carbon. Metal in natural state of the ingot.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotation.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
20,000	0	0	a	.1664	.1467	.1628	.0161	.0036	Hole ″.09 by ″.15 dee, shaft 1″.24 south of south edge of south middle bearing.
	.....	.....	b	.1673	.1480	.1640	.0160	.0033	
	.....	.....	c	.1714	.1490	.1652	.0162	.0062	
	1,000	1,000	a	.1655	.1474	.1635	.0161	.0020	
	.....	.....	b	.1666	.1478	.1640	.0162	.0026	
	.....	.....	c	.1710	.1494	.1656	.0162	.0054	
	10,000	11,000	a	.1666	.1484	.1648	.0164	.0018	
	.....	.....	b	.1668	.1488	.1650	.0162	.0018	
	.....	.....	c	.1695	.1500	.1661	.0161	.0034	
	99,000	110,000	a	.1674	.1496	.1658	.0162	.0016	
	.....	.....	b	.1671	.1503	.1665	.0162	.0006	
	.....	.....	c	.1679	.1508	.1668	.0160	.0011	
	690,250	800,250	.....	.....	.....	.....	.....	.....	Bar ruptured ″.35 south of the south edge of north middle bearing.

No. 324. Marks, 7 × 1, 3.
Turned down from bar 1¼″ diameter. 0.26 per cent carbon. Annealed at high heat.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1652	.1248	.1610	.0362	.0042	
	.....	.....	b	.1681	.1310	.1674	.0364	.0007	
	.....	.....	c	.1675	.1298	.1664	.0366	.0011	
	1,000	1,000	a	.1622	.1289	.1607	.0368	.0015	
	.....	.....	b	.1674	.1295	.1663	.0368	.0011	
	.....	.....	c	.1682	.1294	.1660	.0366	.0022	
	10,000	11,000	a	.1647	.1242	.1613	.0371	.0034	
	.....	.....	b	.1689	.1285	.1658	.0373	.0031	
	.....	.....	c	.1642	.1270	.1639	.0369	.0008	
	91,010	102,010	.....	.....	.....	.....	.....	.....	Bar ruptured ″.55 south of the south edge of north middle bearing.

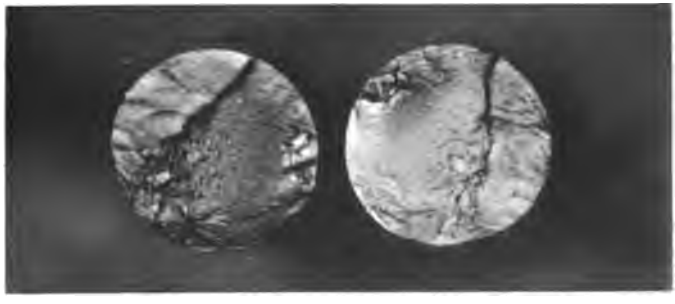
N. S. 3.2.



T. S. 4.

FIG. TUBULE OF ENDURANCE SHAFTS.

NO. 324.



No. 325. Marks, N 3–D.

0.17 per cent carbon, 3.25 per cent nickel. Oil tempered and annealed.

Diameter, 1.″ Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
10,000	0	0	a	.1659	.1575	.1658	.0083	.0001	
	.....	.....	b	.1664	.1579	.1664	.0085	0.	
	.....	.....	c	.1657	.1572	.1657	.0085	0.	
	1,000	1,000	a	.1644	.1560	.1643	.0083	.0001	
	.....	.....	b	.1648	.1562	.1647	.0085	.0001	
	.....	.....	c	.1642	.1557	.1641	.0084	.0001	
	9,000	10,000	a	.1644	.1559	.1644	.0085	0.	
	.....	.....	b	.1648	.1563	.1647	.0084	.0001	
	.....	.....	c	.1641	.1557	.1641	.0084	0.	
15,000	0	10,000	a	.1644	.1518	.1643	.0125	.0001	
	.....	.....	b	.1648	.1522	.1647	.0125	.0001	
	.....	.....	c	.1641	.1514	.1640	.0126	.0001	
	1,000	11,000	a	.1643	.1516	.1643	.0127	0.	
	.....	.....	b	.1648	.1520	.1647	.0127	.0001	
	.....	.....	c	.1641	.1515	.1640	.0125	.0001	
	10,000	21,000	a	.1642	.1516	.1642	.0126	0.	
	.....	.....	b	.1647	.1518	.1646	.0128	.0001	
	.....	.....	c	.1642	.1515	.1641	.0126	.0001	
20,000	0	21,000	a	.1645	.1475	.1643	.0168	.0002	
	.....	.....	b	.1648	.1480	.1646	.0166	.0002	
	.....	.....	c	.1642	.1473	.1640	.0167	.0002	
	1,000	22,000	a	.1644	.1476	.1642	.0166	.0002	
	.....	.....	b	.1647	.1480	.1646	.0166	.0001	
	.....	.....	c	.1642	.1472	.1640	.0168	.0002	
	10,000	32,000	a	.1642	.1474	.1642	.0168	0.	
	.....	.....	b	.1647	.1478	.1647	.0169	0.	
	.....	.....	c	.1642	.1472	.1640	.0168	.0002	
25,000	0	32,000	a	.1641	.1433	.1641	.0208	0.	
	.....	.....	b	.1647	.1435	.1645	.0210	.0002	
	.....	.....	c	.1642	.1430	.1640	.0210	.0002	
	1,000	33,000	a	.1643	.1435	.1642	.0207	.0001	
	.....	.....	b	.1649	.1438	.1647	.0209	.0002	
	.....	.....	c	.1642	.1431	.1640	.0209	.0002	
	10,000	43,000	a	.1644	.1433	.1642	.0209	.0002	
	.....	.....	b	.1647	.1434	.1645	.0211	.0002	
	.....	.....	c	.1642	.1430	.1640	.0210	.0002	
30,000	0	43,000	a	.1642	.1393	.1642	.0249	0.	
	.....	.....	b	.1646	.1393	.1645	.0252	.0001	
	.....	.....	c	.1643	.1388	.1640	.0252	.0003	
	1,000	44,000	a	.1644	.1393	.1642	.0249	.0002	
	.....	.....	b	.1648	.1393	.1645	.0252	.0003	
	.....	.....	c	.1642	.1388	.1640	.0252	.0002	
	10,000	54,000	a	.1643	.1390	.1642	.0252	.0001	
	.....	.....	b	.1646	.1393	.1644	.0251	.0002	
	.....	.....	c	.1639	.1387	.1639	.0252	0.	
	96,000	150,000	a	.1645	.1389	.1642	.0253	.0003	
	.....	.....	b	.1648	.1391	.1646	.0255	.0002	
	.....	.....	c	.1643	.1388	.1640	.0252	.0003	
	66,580	216,580	.....	.....	.....	.....	.....	.....	Bar ruptured 1″.20 south of the south edge of north middle bearing.

No. 327. Marks, C 3–D.
0.20 per cent carbon. Oil tempered and annealed.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on a chord of 10′.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
20,000	0	0	a	.1648	.1486	.1648	.0162	0.	
	.....	.....	b	.1643	.1483	.1643	.0160	0.	
	.....	.....	c	.1645	.1481	.1644	.0163	.0001	
	1,000	1,000	a	.1648	.1484	.1648	.0164	0.	
	.....	.....	b	.1644	.1480	.1642	.0162	.0002	
	.....	.....	c	.1644	.1483	.1643	.0160	.0001	
	109,000	110,000	a	.1647	.1487	.1647	.0160	0.	
	.....	.....	b	.1644	.1482	.1644	.0162	0.	
	.....	.....	c	.1644	.1483	.1644	.0161	0.	
	8,890,000	9,000,000	a	.1647	.1483	.1645	.0162	.0002	
	.....	.....	b	.1650	.1488	.1650	.0162	0.	
	.....	.....	c	.1646	.1483	.1646	.0163	0.	
25,000	0	9,000,000	a	.1647	.1445	.1645	.0200	.0002	
	.....	.....	b	.1650	.1448	.1650	.0202	0.	
	.....	.....	c	.1646	.1445	.1645	.0200	.0001	
	1,000	9,001,000	a	.1646	.1447	.1645	.0198	.0001	
	.....	.....	b	.1652	.1450	.1650	.0200	.0002	
	.....	.....	c	.1647	.1444	.1645	.0201	.0002	
	9,000	9,010,000	a	.1645	.1442	.1644	.0202	.0001	
	.....	.....	b	.1650	.1447	.1650	.0203	0.	
	.....	.....	c	.1646	.1443	.1645	.0202	.0001	
	990,000	10,000,000	a	.1645	.1439	.1644	.0205	.0001	
	.....	.....	b	.1652	.1437	.1640	.0203	.0012	
	.....	.....	c	.1649	.1442	.1646	.0204	.0003	
30,000	0	10,000,000	a	.1647	.1399	.1644	.0245	.0003	
	.....	.....	b	.1652	.1403	.1648	.0245	.0004	
	.....	.....	c	.1648	.1402	.1645	.0243	.0003	
	1,000	10,001,000	a	.1643	.1396	.1642	.0246	.0001	
	.....	.....	b	.1658	.1402	.1648	.0246	.0005	
	.....	.....	c	.1650	.1401	.1645	.0244	.0005	
	9,000	10,010,000	a	.1648	.1394	.1641	.0247	.0007	
	.....	.....	b	.1652	.1397	.1644	.0247	.0008	
	.....	.....	c	.1652	.1400	.1646	.0246	.0006	
	19,940	10,029,940	.....	.....	.....	.....	.....	.....	Bar ruptured 0.85 south of the south edge of north middle bearing, beginning at a small cavity at the circumference.

NO. 327.

NO. 328.

FRACTURED ENDS OF ENDURANCE SHAFTS.

HELIOTYPE CO., BOSTON.

No. 330. Marks, 7×1, 2.

Turned down from bar 1¼″ diameter. 0.26 per cent carbon. Annealed at low heat.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1638	.1268	.1637	.0369	.0001	
			b	.1633	.1263	.1632	.0369	.0001	
	1,000	1,000	a	.1637	.1267	.1637	.0370	0.	
			b	.1634	.1263	.1633	.0370	.0001	
	9,000	10,000	a	.1639	.1266	.1636	.0370	.0003	
			b	.1635	.1262	.1631	.0369	.0004	
	90,000	100,000	a	.1640	.1262	.1634	.0372	.0006	
			b	.1628	.1257	.1628	.0371	0.	
	1,772,340	1,872,340							Bar ruptured 1″.35 south of the south edge of north middle bearing.

No. 331. Marks, 7×1, 4.

Turned down from bar 1¼″ diameter. 0.26 per cent carbon. Annealed at high heat.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1639	.1267	.1636	.0369	.0003	
			b	.1638	.1269	.1635	.0366	.0003	
	1,000	1,000	a	.1643	.1263	.1629	.0366	.0014	
			b	.1644	.1262	.1630	.0368	.0014	
	9,000	10,000	a	.1635	.1255	.1623	.0368	.0012	
			b	.1650	.1253	.1624	.0371	.0026	
	90,000	100,000	a	.1649	.1243	.1625	.0382	.0024	
			b	.1658	.1249	.1625	.0376	.0033	
	235,100	335,100							Bar ruptured 1″.30 south of the south edge of north middle bearing.

NO. 329.

NO. 330.

FRACTURED ENDS OF ENDURANCE SHAFTS.

HELIOTYPE CO., BOSTON.

No. 332. Marks, 7×1, 6.
Turned down from bar 1¼″ diameter; 0.26 per cent carbon. Oil-tempered and annealed at low heat.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Set.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1631	.1262	.1630	.0868	.0001	
			b	.1637	.1263	.1631	.0868	.0006	
	1,000	1,000	a	.1635	.1262	.1630	.0868	.0005	
			b	.1636	.1262	.1630	.0868	.0006	
	9,000	10,000	a	.1628	.1257	.1627	.0870	.0001	
			b	.1639	.1260	.1629	.0869	.0010	
	90,000	100,000	a	.1640	.1257	.1628	.0871	.0012	
			b	.1639	.1256	.1627	.0871	.0012	
	1,175,850	1,275,850							Bar ruptured 1″.05 south of the south edge of north middle bearing.

No. 333. Marks, 7 × 1, 8.
Turned down from bar 1¼″ diameter. 0.26 per cent carbon. Oil tempered and annealed at high heat.
Diameter, 1″. Speed of rotation, 500 per minute.
Length between end supports, 33″.
Loaded over 4″ length at middle.
Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1635	.1266	.1634	.0868	.0001	
			b	.1646	.1276	.1645	.0869	.0001	
	1,000	1,000	a	.1632	.1262	.1630	.0868	.0002	
			b	.1650	.1280	.1648	.0868	.0002	
	9,000	10,000	a	.1630	.1259	.1628	.0869	.0002	
			b	.1654	.1283	.1652	.0869	.0002	
	90,000	100,000	a	.1630	.1256	.1628	.0872	.0002	
			b	.1654	.1279	.1651	.0872	.0003	
	4,778,310	4,878,310							Bar ruptured 1″.50 north of the north edge of south middle bearing.

No. 336. Marks, 7 × 2, 3.

Turned down from bar 1¼″ diameter. 0.25 per cent carbon. Annealed at high heat.

Diameter, 1″. Speed of rotation, 500 per minute.

Length between end supports, 33″.

Loaded over 4″ length at middle.

Deflections measured on chord of 10″.

Maximum fiber stress per square inch.	Number of rotations.		Micrometer readings for deflections.				Deflections.	Sets.	Remarks.
	Successive.	Total.	On line.	Unloaded.	Loaded.	Unloaded.			
Pounds.				*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	
45,000	0	0	a	.1657	.1260	.1634	.0374	.0023	
			b	.1653	.1257	.1629	.0372	.0024	
	1,000	1,000	a	.1643	.1260	.1636	.0376	.0007	
			b	.1652	.1254	.1628	.0374	.0024	
	9,000	10,000	a	.1637	.1263	.1637	.0374	0.	
			b	.1652	.1253	.1628	.0375	.0024	
	90,000	100,000	a	.1658	.1268	.1640	.0372	.0018	
			b	.1647	.1252	.1628	.0376	.0019	
	535,600	635,600							Bar ruptured ″.10 south of the north edge of north middle bearing, under the north middle bearing.

NO. 336.

NO. 336.

FRACTURED ENDS OF ENDURANCE SHAFTS.

HELIOTYPE CO., BOSTON.

ENDURANCE OF ROTATING SHAFTS.

SUMMARIZED TABULATION.

Speed of rotation, 500 per minute.

No. of test.	Marks.	Material.	Treatment.	Composition.				Maximum fiber stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.	Ni.		Successive.	Total.	
								Pounds.			
300	9-C 1	Gautier steel	Hot rolled bar.....	.82	.36	.10	.....	30,000	49,487,300	.....	49,477,300 rotations at 1,800 per minute, remainder at 500 per minute.
								35,000	10,000		
								40,000	10,000		
								45,000	133,840	49,641,140	Ruptured at the south edge of north middle bearing.
301	7 B 17 Y 1 1	Bethlehem steel..	Treated bar	.32	1.20	.60	.....	40,000	80,119,000	.....	80,118,000 rotations at 750 per minute, remainder at 500 per minute.
								45,000	6,499,000		
								50,000	7,993,490		
								55,000	907,520	95,519,010	Ruptured ″.50 south of south edge of south middle bearing.
308	11-C 3	Gautier steel	Hot rolled bar.....	1.09	.39	.11	.....	40,000	130,500,000		
								45,000	1,017,300	131,517,300	Ruptured ″.10 south of south edge of north middle bearing.
309	7-B 1	.....do	.....do	.73	.64	.04	.....	40,000	150,000,000		
								45,000	9,500,000		
								50,000	354,050	159,854,050	Bar ruptured midway between north and south middle bearings.
310	9-C 2	.....do	.....do	.82	.36	.10	.....	40,000	152,500,720		
								45,000	1,771,260	154,271,980	Bar ruptured 1″.10 south of south edge of north middle bearing.
321	7×2, 1	Bethlehem steel..	Annealed at low heat.....	.25	.66	.08	4.60	40,000	45,000,000		
								45,000	922,640	45,922,640	Ruptured ″.08 south of the north edge of north middle bearing.
322	N 3-E	Nickel-steel ingot.	Natural state	.17	.68	.....	3.25	10,000	10,000		
								15,000	11,000		
								20,000	11,000		
								25,000	11,000		
								30,000	85,840	128,840	Ruptured 1″.25 north of north edge of south middle bearing.
323	C 3-E	Carbon-steel ingot.	.....do	.20	.58	.....	.....	20,000	800,250	800,250	Ruptured ″.35 south of south edge of north middle bearing.
324	7×1, 3	Bethlehem steel..	Annealed at high heat.....	.26	.52	.12	3.31	45,000	102,010	102,010	Ruptured ″.55 south of south edge of north middle bearing.

ENDURANCE OF ROTATING SHAFTS—Continued.

SUMMARIZED TABULATION—Continued.

No. of test.	Marks.	Material.	Treatment.	Composition.				Maximum fiber stress per square inch.	Number of rotations.		Remarks.
				C.	Mn.	Si.	Ni.		ssive.	Total.	
								Pounds.			
325	N 3-D	Nickel-steel ingot.	Oil tempered and annealed.	.17	.68	.....	3.25	10,000	10,000		
								15,000	11,000		
								20,000	11,000		
								25,000	11,000		
								30,000	173,580	216,580	Ruptured 1".20 south of south edge of north middle bearing.
327	C 3-D	Carbon-steel ingot.	.....do.....	.20	.58	.....	.....	20,000	9,000,000		
								25,000	1,000,000		
								30,000	29,940	10,029,940	Ruptured ".85 south of south edge of north middle bearing, beginning at a small cavity at the circumference.
328	7×2, 5	Bethlehem steel..	Oil tempered and annealed at low heat.	.25	.66	.08	4.60	45,000	4,396,480	4,396,480	Shaft ruptured at north edge of south middle bearing.
329	7×1, 5	.....do.....	.....do.....	.26	.52	.12	3.31	45,000	194,470	194,470	Ruptured 1".10 south of south edge of north middle bearing.
330	7×1, 2	.....do.....	Annealed at low heat.....	.26	.52	.12	3.31	45,000	1,872,340	1,872,340	Ruptured 1".35 south of south edge of north middle bearing.
331	7×1, 4	.....do.....	Annealed at high heat.....	.26	.52	.12	3.31	45,000	335,100	335,100	Ruptured 1".30 south of south edge of north middle bearing.
332	7×1, 6	.....do.....	Oil tempered and annealed at low heat.	.26	.52	.12	3.31	45,000	1,275,850	1,275,850	Ruptured 1".05 south of south edge of north middle bearing.
333	7×1, 8	.....do.....	Oil tempered and annealed at high heat.	.26	.52	.12	3.31	45,000	4,878,310	4,878,310	Ruptured 1".50 north of north edge of south middle bearing.
336	7×2, 3	.....do.....	Annealed at high heat.....	.25	.66	.08	4.60	45,000	635,600	635,600	Ruptured in the north middle bearing.

Chemical Analyses, Endurance Shafts.

CHEMICAL ANALYSES OF MATERIAL IN ENDURANCE SHAFTS.

WATERTOWN ARSENAL DETERMINATIONS.

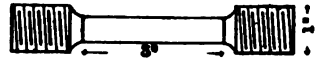
No. of shaft.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Copper.	Nickel.
280	.281	.522	.122	.048	.024	.038	3.264
282	.500	.980	.300	.060	.044	.200	27.601
284	.471	.661	.123	.030	.024	.....	.....
286	.415	.552	.182	.030	.028	.....	.....
288	.241	.660	.105	.035	.040	.....	.....
290	.290	.763	.138	.035	.021	.072	5.753
292	.252	.652	.079	.029	.022	.057	4.550
293	.250	.642	.083	.032	.021	.056	4.50
294	.700	.450	.230	.040	.026	.....	.....
321	.255	.645	.082	.027	.022	.055	4.601
324	.275	.550	.140	.050	.029	.036	3.310

TENSILE SPECIMENS FROM ENDS OF RUPTURED ENDURANCE SHAFTS.

TENSILE SPECIMENS FROM RUPTURED ENDURANCE SHAFTS.

Specimens taken from the ends of the ruptured bars.

The marks give the test number of the endurance shaft, also the figures and letters which were employed to identify the grade and treatment of the metal.



No. 7492.

Bethlehem Steel, Nickel. Annealed.
Marks, 280, 7×1 S.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see Report of 1895, page 578.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
35,000	.0035	.....	
40,000	.0040	0.	
50,000	.0050	0.	
55,000	.0055	.0001	Elastic limit.
50,000	.0410	.....	On reapplication of load, rapid elongation took place at about 55,000 pounds load.
51,000	.0435	.....	
52,000	.0460	.....	
53,000	.0490	.....	
54,000	.0540	.....	
55,000	.0598	.0524	
56,000	.0658	.....	
58,000	.0710	.....	
60,000	.0850	.....	
62,000	.0960	.....	
64,000	.1090	.....	
66,000	.1230	.....	
68,000	.1430	.....	
70,000	.1600	.....	
72,000	.20	.....	
74,000	.23	.....	
76,000	.27	.....	
78,000	.33	.....	
79,840	.....	.....	Tensile strength.
0	.90	.....	= 30 per cent.

Elongation of inch sections, ".18, ".52,* ".20.
Diameter at fracture, ".36; area, .1018 square inch.
Contraction of area, 59.3 per cent.
Fractured at middle of stem.
Appearance, fine silky.

No. 7493.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Marks, 281, 7×1 HS.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see Report of 1895, page 579.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	0.	
35,000	.0036	.....	
40,000	.0041	0.	
50,000	.0051	0.	
55,000	.0058	0.	
60,000	.0063	0.	
64,000	.0068	.....	Elastic limit.
65,000	.0076	.0011	
60,000	.0185	.....	
61,000	.0400	.....	
62,000	.0480	.....	
64,000	.0550	.....	
66,000	.0630	.....	
68,000	.0700	.....	
70,000	.0835	.0740	
72,000	.10	.....	
74,000	.11	.....	
76,000	.12	.....	
78,000	.14	.....	
80,000	.16	.....	
82,000	.18	.....	
84,000	.21	.....	
86,000	.25	.....	
88,000	.32	.....	
89,680	.....	.....	Tensile strength.
0	.76	.....	= 25.3 per cent.

Elongation of inch sections, ".14, ".19, ".43*.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured 1".1 from the neck. Appearance, fine silky.

No. 7494.

Bethlehem Steel, Nickel. Annealed.
Marks, 282, 7×4 S.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 584.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0012	.....	
20,000	.0024	.....	
30,000	.0039	0.	
35,000	.0044	.....	
40,000	.0051	0.	
45,000	.0058	0.	
50,000	.0067	.0001	
54,000	.0072	.....	Elastic limit.
55,000	.0079	.0009	
56,000	.0089	.....	
57,000	.0093	.....	
58,000	.0101	.....	
59,000	.0110	.....	
60,000	.0129	.0058	
61,000	.0139	.....	
62,000	.0178	.....	
63,000	.0190	.....	
64,000	.0280	.....	
65,000	.0292	.0207	
66,000	.0308	.....	
68,000	.0520	.....	
70,000	.0671	.....	
74,000	.10	.....	
78,000	.14	.....	
82,000	.17	.....	
86,000	.21	.....	
90,000	.26	.....	
94,000	.32	.....	
111,200	.....	.....	Tensile strength.
0	1.07	.....	= 35.7 per cent.

Elongation of inch sections, ″.28, ″.29, ″.50*.
Diameter at fracture, ″.37; area, .1075 square inch.
Contraction of area, 57 per cent.
Fractured 1″.1 from the neck. Appearance, fine silky, serrated.

No. 7495.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Marks, 283, 7×4 HS.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 585.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inches.*	*Inch.*	
1,000	0.	.0	Initial load.
5,000	.0005	.0	
10,000	.0011	.....	
20,000	.0024	.....	
30,000	.0038	0.	
35,000	.0043	.....	
40,000	.0050	0.	
42,000	.0054	.....	Elastic limit.
43,000	.0050	.....	
44,000	.0062	.....	
45,000	.0070	.0011	
46,000	.0108	.....	
47,000	.0135	.....	
48,000	.0275	.....	
49,000	.0290	.....	
50,000	.0390	.0325	
52,000	.0575	.....	
54,000	.0772	.....	
56,000	.0925	.....	
60,000	.1358	.....	
64,000	.17	.....	
68,000	.21	.....	
70,000	.22	.....	
74,000	.27	.....	
78,000	.32	.....	
82,000	.37	.....	
86,000	.42	.....	
90,000	.49	.....	
94,000	.59	.....	
98,000	.71	.....	
103,520	.....	.....	Tensile strength.
0	1.33	.....	= 44.3 per cent.

Elongation of inch sections, ″.33, ″.39, ″.61*.
Diameter at fracture, ″.35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured 1″.1 from the neck. Appearance, fine silky

No. 7496.

Bethlehem Steel. Annealed.
Marks, 284, 7 × 7 S.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 588.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
35,000	.0035	.....	
40,000	.0040	0.	
45,000	.0047	0.	
48,000	.0050	.....	
49,000	.0051	.....	Elastic limit.
50,000	.....	.....	Momentarily reached, load fell.
45,000	.0122	.....	
46,000	.0142	.....	
47,000	.0230	.....	
48,000	.0257	.....	
49,000	.0265	.....	
50,000	.0290	.....	
51,000	.0311	.....	
52,000	.0332	.....	
54,000	.0375	.....	
56,000	.0422	.....	
60,000	.0525	.....	
64,000	.0639	.....	
68,000	.0760	.....	
72,000	.0910	.....	
76,000	.1067	.....	
80,000	.1325	.....	
84,000	.17	.....	
88,000	.21	.....	
92,000	.33	.....	
94,080	.....	.....	Tensile strength.
0	.75	.....	= 25 per cent.

Elongation of inch sections, ″.16, ″.40*, ″.19.
Diameter at fracture, ″.42; area, .1385 square inch.
Contraction of area, 44.6 per cent.
Fractured 1″.56 from the neck. Appearance, silky.

No. 7497.

Bethlehem Steel. Oil hardened and annealed.
Marks, 285, 7×7 HS.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see Report of 1895, page 589.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0031	.....	
35,000	.0037	.....	
40,000	.0042	0.	
45,000	.0048	.....	
50,000	.0053	0.	
55,000	.0059	.....	
60,000	.0062	0.	
61,000	.0063	.....	
62,000	.0065	.....	Elastic limit.
60,000	.0135	.....	
61,000	.0250	.....	
62,000	.0260	.....	
63,000	.0270	.....	
64,000	.0290	.....	
66,000	.0332	.....	
68,000	.0387	.....	
72,000	.0480	.....	
76,000	.0580	.....	
80,000	.0700	.....	
84,000	.0840	.....	
88,000	.0985	.....	
92,000	.1190	.....	
96,000	.15	.....	
100,000	.20	.....	
104,000	.31	.....	
105,120	.....	.....	Tensile strength.
0	.62	.....	=20.7 per cent.

Elongation of inch sections, ".13, ".13, ".36*.
Diameter at fracture, ".40; area, .1257 square inch.
Contraction of area, 49.7 per cent.
Fractured ".9 from the neck. Appearance, silky, cup-shaped.

No. 7498.

Bethlehem Steel. Annealed.
Marks, 286, 7×6 S.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see Report of 1895, page 587.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	.....	
35,000	.0034	.....	
40,000	.0039	0.	
44,000	.0043	.....	
45,000	.0044	.....	Elastic limit.
42,000	.0090	.....	
43,000	.0150	.....	
44,000	.0336	.....	
45,000	.0341	.....	
46,000	.0360	.....	
47,000	.0385	.....	
48,000	.0420	.....	
50,000	.0485	.....	
52,000	.0550	.....	
56,000	.0700	.....	
60,000	.0845	.....	
64,000	.1050	.....	
68,000	.1330	.....	
72,000	.1630	.....	
76,000	.22	.....	
80,000	.32	.....	
82,480	.....	.....	Tensile strength.
0	.87	.....	=29 per cent.

Elongation of inch sections, ".20, ".45*, ".22.
Diameter at fracture, ".39; area, .1194 square inch.
Contraction of area, 52.2 per cent.
Fractured 1".5 from the neck. Appearance, silky.

No. 7499.

Bethlehem Steel. Oil hardened and annealed.
Marks, 287, 7×6 HS.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 587.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	.....	
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0030	.....	
35,000	.0035	.....	
40,000	.0040	0.	
50,000	.0050	0.	
54,000	.0054	.....	
55,000	.0056	.....	Elastic limit.
51,000	.0150	.....	Load fell.
52,000	.0225	.....	
53,000	.0245	.....	
54,000	.0270	.....	
55,000	.0295	.....	
56,000	.0328	.....	
58,000	.0385	.....	
60,000	.0450	.....	
64,000	.0580	.....	
68,000	.0720	.....	
72,000	.0900	.....	
76,000	.1105	.....	
80,000	.1390	.....	
84,000	.18	.....	
88,000	.26	.....	
90,000	.....	.....	Tensile strength.
0	.75	.....	=25 per cent.

Elongation of inch sections, ″.15, ″.22, ″.38*.
Diameter at fracture, ″.36; area, .1018 square inch.
Contraction of area, 59.3 per cent.
Fractured 1″.17 from the neck. Appearance, silky.

No. 7500.

Bethlehem Steel. Annealed.
Marks, 288, 7×5 S.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see report of 1895, page 586.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	.....	
35,000	.0033	.....	
40,000	.0039	0.	
41,000	.0040	.....	Elastic limit.
37,000	.0175	.....	
38,000	.0210	.....	
39,000	.0320	.....	
40,000	.0450	.....	
41,000	.0458	.....	
42,000	.0490	.....	
43,000	.0520	.....	
44,000	.0570	.....	
46,000	.0650	.....	
48,000	.0740	.....	
52,000	.0980	.....	
56,000	.1265	.....	
60,000	.17	.....	
64,000	.23	.....	
68,000	.33	.....	
70,880	.....	.....	Tensile strength.
0	.99	.....	= 33 per cent.

Elongation of inch sections, ″.22, ″.55*, ″.22.
Diameter at fracture, ″.35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured 1″.84 from the neck. Appearance, silky.

No. 7501.

Bethlehem Steel. Oil hardened and annealed.
Marks, 289, 7 × 5 HS.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 586.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
35,000	.0036	.....	
40,000	.0040	0.	
44,000	.0043	.....	Elastic limit
45,000	.0070	.....	
40,000	.0110	.....	
41,000	.0140	.....	
42,000	.0285	.....	
43,000	.0305	.....	
44,000	.0350	.....	
45,000	.0380	.....	
46,000	.0430	.....	
48,000	.0515	.....	
52,000	.0700	.....	
56,000	.0930	.....	
60,000	.1210	.....	
64,000	.16	.....	
68,000	.22	.....	
72,000	.47	.....	
72,080	.....	.....	Tensile strength.
0	.92	.....	= 30.7 per cent.

Elongation of inch sections, ″.27, ″.49*, ″.16.
Diameter at fracture, ″.31; area, .0755 square inch.
Contraction of area, 69.8 per cent.
Fractured 1″.5 from the neck. Appearance, silky

No. 7502.

Bethlehem Steel, Nickel. Annealed.
Marks, 290, 7×3 S.
Diameter, ".564.
Sectional area, .25 square inch
Gauged length, 3".
For endurance test see Report of 1895, page 582.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000.	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
35,000	.0036	.....	
40,000	.0041	0.	
50,000	.0052	0.	
60,000	.0063	0.	
65,000	.0069	0.	
70,000	.0073	0.	
75,000	.0079	0.	
78,000	.0085	.....	Elastic limit.
79,000	.0088	.....	
80,000	.0109	.0021	
81,000	.0123	.....	
82,000	.0210	.....	
83,000	.0260	.....	
84,000	.0320	.....	
88,000	.0575	.....	
92,000	.0820	.....	
96,000	.1045	.....	
100,000	.1390	.....	
104,000	.18	.....	
108,000	.32	.....	Tensile strength.
0	.57	.....	=19 per cent.

Elongation of inch sections: ".37*, ".11, ".09.
Diameter at fracture, ".37; area, .1075 square inch.
Contraction of area, 57 per cent.
Fractured ".9 from the neck. Appearance, fine silky.

No. 7503.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Marks, 291, 7×3 HS.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see Report of 1895, page 583.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
40,000	.0041	0.	
50,000	.0052	0.	
60,000	.0061	0.	
70,000	.0071	0.	
75,000	.0076	0.	
80,000	.0081	0.	
90,000	.0091	0.	
100,000	.0101	0.	
108,000	.0108	.....	
109,000	.0110	.....	Elastic limit.
110,000	.0190	.....	
111,000	.0480	.....	
112,000	.0590	.....	
114,000	.0680	.....	
116,000	.0850	.....	
118,000	.11	.....	
120,000	.13	.....	
124,000	.19	.....	
125,760	.....	.....	Tensile strength.
0	.55	.....	=18.3 per cent.

Elongation of inch sections: ".35*, ".12, ".08.
Diameter of fracture, ".35, area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured ".95 from the neck. Appearance, fine silky, serrated.

No. 7504.

Bethlehem Steel, Nickel. Annealed.
Marks, 292, 7 × 2 S.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 580.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
35,000	.0036	.....	
40,000	.0041	0.	
50,000	.0051	0.	
60,000	.0062	0.	
62,000	.0065	.....	Elastic limit.
61,000	.0390	.....	
62,000	.0450	.....	
63,000	.0470	.....	
64,000	.0520	.....	
66,000	.0580	.....	
68,000	.0640	.....	
72,000	.0840	.....	
76,000	.1050	.....	
80,000	.1320	.....	
84,000	.18	.....	
88,000	.23	.....	
92,000	.35	.....	
92,880	.....	.....	Tensile strength.
0	.75	.....	= 25 per cent.

Elongation of inch sections: ″.15, ″.25, ″.35*.
Diameter at fracture, ″.37; area, .1075 square inch.
Contraction of area, 57 per cent.
Fractured 1″.25 from the neck: Appearance, fine silky, cup-shaped.

No. 707.

Bethlehem Steel. Oil hardened and annealed.
Marks. 295. 7 / 8 HS.
Diameter. ".504.
Sectional area. .25 square inch.
Gauged length. 3."
For endurance test see Report of 1905, page 501.

Load.	Elongation of 3"	Remarks.
Pounds.	Inch.	Inch.	
1,000	.0004	0.	
2,000	.0008	0.	
3,000	.0012	0.	
4,000	.0016	0.	
5,000	.0020	0.	

No. 7508.

Gautier Steel. Hot rolled bar.
Marks, 300, 9-C1.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test, see present Report, page 259.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
50,000	.0050	0.	
60,000	.0060	0.	
66,000	.0067	.....	Elastic limit.
67,000	.0073	.....	
68,000	.0111	.....	
69,000	.0120	.....	
70,000	.0136	.....	
72,000	.0160	.....	
74,000	.0178	.....	
76,000	.0195	.....	
78,000	.0215	.....	
80,000	.0235	.0130	
84,000	.0280	.....	
88,000	.0335	.....	
92,000	.0383	.....	
96,000	.0443	.....	
100,000	.0500	.0349	
104,000	.06	.....	
108,000	.07	.....	
116,000	.08	.....	
124,000	.10	.....	
132,000	.12	.....	
140,000	.16	.....	
147,600	.....	.....	Tensile strength.
0	.27	.....	=9 per cent.

Elongation of inch sections: ".08, ".11*, ".08*.
Diameter at fracture, ".54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Fractured 1".2 from the neck. Appearance, fine granular.

No. 7505.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Marks, 293, 7×2 HS.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see Report of 1895, page 581.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load:
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
50,000	.0051	0.	
60,000	.0061	0.	
70,000	.0071	0.	
80,000	.0081	0.	
90,000	.0091	0.	
100,000	.0101	0.	
101,000	.0108	.....	Elastic limit.
97,000	.0150	.....	
98,000	.0190	.....	
99,000	.0310	.....	
100,000	.0520	.....	
101,000	.0600	.....	
102,000	.0650	.....	
104,000	.0835	.....	
106,000	.0973	.....	
108,000	.1140	.....	
112,000	.1500	.....	
116,000	.24	.....	
116,800	.....	.....	Tensile strength.
0	.57	.....	=19 per cent.

Elongation of inch sections: ″.10, ″.17, ″.30*.
Diameter at fracture, ″.36; area, .1018 square inch.
Contraction of area, 59.3 per cent.
Fractured 1″.15 from neck. Appearance, fine silky, serrated.

No. 7506.

Bethlehem Steel. Annealed.
Marks, 294, 7×8 S.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see Report of 1895, page 590.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0029	.....	
40,000	.0039	0.	
50,000	.0049	0.	
56,000	.0057	.....	Elastic limit.
57,000	.0075	.....	
58,000	.0089	.....	
59,000	.0102	.....	
60,000	.0112	.0043	
61,000	.0123	.....	
62,000	.0137	.....	
64,000	.0160	.....	
68,000	.0220	.....	
72,000	.0275	.....	
76,000	.0330	.....	
80,000	.0390	.....	
84,000	.0455	.....	
88,000	.0530	.....	
92,000	.0603	.....	
96,000	.0680	.....	
100,000	.0785	.....	
104,000	.09	.....	
108,000	.10	.....	
112,000	.12	.....	
116,000	.13	.....	
120,000	.15	.....	
124,000	.19	.....	
127,760	.....	.....	Tensile strength.
0	.35	.....	=11.7 per cent.

Elongation of inch sections: ".08, ".10, ".17*.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured ".8 from the neck. Appearance, granular, dull silky spot near the center.

No. 7507.

Bethlehem Steel. Oil hardened and annealed.
Marks, 295, 7×8 HS.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3."
For endurance test see Report of 1895, page 591.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
50,000	.0050	0.	
60,000	.0061	0.	
70,000	.0071	0.	
80,000	.0081	0.	
82,000	.0084	.....	Elastic limit.
83,000	.0089	.....	
84,000	.0099	.....	
85,000	.0113	.....	
86,000	.0129	.....	
88,000	.0140	.....	
90,000	.0158	.....	
92,000	.0178	.....	
96,000	.0230	.....	
100,000	.0288	.....	
104,000	.0342	.....	
108,000	.0400	.....	
112,000	.0460	.....	
116,000	.0540	.....	
120,000	.0608	.0450	
128,000	.08	.....	
136,000	.10	.....	
144,000	.13	.....	
152,000	.25	.....	
152,600	.....	.....	Tensile strength.
0	.38	.....	= 12.7 per cent.

Elongation of inch sections: ".08, ".17*,".13*.
Diameter at fracture, ".47; area, .1735 square inch.
Contraction of area, 30.6 per cent.
Fractured 1".13 from the neck. Appearance, fine granular, dull silky spot at center.

No. 7508.

Gautier Steel. Hot rolled bar.
Marks, 300, 9-C1.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test, see present Report, page 259.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
50,000	.0050	0.	
60,000	.0060	0.	
66,000	.0067	.....	Elastic limit.
67,000	.0073	.....	
68,000	.0111	.....	
69,000	.0120	.....	
70,000	.0136	.....	
72,000	.0160	.....	
74,000	.0178	.....	
76,000	.0195	.....	
78,000	.0215	.....	
80,000	.0285	.0130	
84,000	.0280	.....	
88,000	.0335	.....	
92,000	.0383	.....	
96,000	.0443	.....	
100,000	.0500	.0349	
104,000	.06	.....	
108,000	.07	.....	
116,000	.08	.....	
124,000	.10	.....	
132,000	.12	.....	
140,000	.16	.....	
147,600	.....	.....	Tensile strength.
0	.27	.....	=9 per cent.

Elongation of inch sections: ″.08, ″.11*, ″.08*.
Diameter at fracture, ″.54; area, .2290 square inch.
Contraction of area, 8.4 per cent.
Fractured 1″.2 from the neck. Appearance, fine granular.

No. 7563.

Bethlehem Steel. Treated bar
Marks, 301, 7 B17 Y 1–1.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test, see present Report, page 260.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
40,000	.0041	0.	
50,000	.0051	.....	
60,000	.0061	0.	
70,000	.0071	0.	
80,000	.0080	0.	
90,000	.0090	0.	
91,000	.0092	.....	Elastic limit.
92,000	.0146	.....	
93,000	.0154	.....	
94,000	.0162	.....	
95,000	.0180	.....	
96,000	.0199	.....	
98,000	.0240	.....	
100,000	.0300	.0188	
102,000	.0360	.....	
104,000	.0410	.....	
106,000	.0475	.....	
110,000	.0600	.0462	
114,000	.07	.....	
120,000	.09	.....	
124,000	.12	.....	
128,000	.15	.....	
130,400	.....	.....	Tensile strength.
0	.35	.....	= 11.7 per cent.

Elongation of inch sections: ″.04, ″.04, ″.27*.
Diameter at fracture, ″.40; area, .1257 square inch.
Contraction of area, 49.7 per cent.
Fractured ″.4 from the neck. Appearance, fine silky, serrated.
Load at time of fracture, 25,200 pounds = 200,480 pounds per square inch on area at rupture.

No. 7509.

Gautier Steel. Hot rolled bar.
Marks, 308, 11-C3.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 261.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
50,000	.0050	0.	
60,000	.0060	0.	
70,000	.0070	0.	
74,000	.0074	.....	Elastic limit.
78,000	.0152	.....	
74,000	.0200	.....	
75,000	.0243	.....	
76,000	.0256	.....	
78,000	.0293	.....	
79,000	.0320	.....	
80,000	.0342	.....	
84,000	.0384	.....	
88,000	.0438	.....	
92,000	.0480	.....	
96,000	.0530	.....	
100,000	.0590	.0418	
108,000	.07	.....	
115,400	.....	.....	Tensile strength.
0	.07	.....	= 2.3 per cent.

Elongation of inch sections: ".02, ".02, ".03*.
Diameter at fracture, ".56; area, .2463 square inch.
Contraction of area, 1.5 per cent.
Fractured ".3 from the neck. Appearance, fine granular.

No. 7544.

Gautier Steel. Hot rolled bar.
Marks, 309, 7-B1.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 263.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
45,000	.0046	.....	
50,000	.0051	0.	
60,000	.0062	.0001	
63,000	.0066	.....	Elastic limit.
64,000	.0072	.....	
65,000	.0089	.....	
66,000	.0100	.....	
67,000	.0110	.....	
68,000	.0118	.....	
70,000	.0139	.0051	
72,000	.0160	.....	
76,000	.0205	.....	
80,000	.0248	.0151	
84,000	.0310	.....	
88,000	.0370	.....	
92,000	.0433	.....	
96,000	.0500	.....	
100,000	.0576	.0421	
108,000	.07	.....	
116,000	.09	.....	
124,000	.12	.....	
136,000	.22	.....	
139,120	.....	.....	Tensile strength.
0	.30	.....	=10 per cent.

Elongation of inch sections: ".13*, ".10, ".07.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured 1" from the neck. Appearance, fine granular.

No. 7510.

Gautier Steel. Hot rolled bar.
Marks, 310, 9-C 2.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 264.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0040	0.	
50,000	.0050	0.	
60,000	.0060	0.	
67,000	.0069	.....	Elastic limit.
68,000	.0108	.....	
69,000	.0117	.....	
70,000	.0126	.0042	
72,000	.0148	.....	
74,000	.0162	.....	
76,000	.0188	.....	
80,000	.0228	.....	
84,000	.0272	.....	
88,000	.0321	.....	
92,000	.0372	.....	
96,000	.0424	.....	
100,000	.0490	.0338	
108,000	.07	.....	
116,000	.08	.....	
124,000	.09	.....	
132,000	.12	.....	
140,000	.16	.....	
147,600	.....	.....	Tensile strength.
0	.27	.....	= 9 per cent.

Elongation of inch sections: ".09, ".10*, ".08.
Diameter at fracture, ".53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Fractured 1".37 from the neck. Appearance, fine granular.

No. 7511.

Bethlehem Steel. Annealed at low heat.
Marks, 321, 7×2, 1.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 266.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0009	.....	
20,000	.0019	.....	
30,000	.0030	.....	
35,000	.0035	.....	
40,000	.0041	0.	
45,000	.0047	0.	
50,000	.0051	0.	
55,000	.0056	0.	
60,000	.0061	0.	
65,000	.0068	.0001	Elastic limit.
66,000	.0071	.....	
67,000	.0074	.....	
68,000	.0078	.....	
69,000	.0090	.....	
70,000	.0190	.0111	
72,000	.0280	.....	
74,000	.0375	.....	
76,000	.0450	.....	
80,000	.0603	.0500	
84,000	.08	.....	
88,000	.10	.....	
92,000	.12	.....	
96,000	.15	.....	
100,000	.20	.....	
104,000	.30	.....	
104,800	.....	.....	Tensile strength.
0	.49	.....	=16.3 per cent.

Elongation of inch sections: ".31*, ".09, ".09.
Diameter at fracture, ".43; area, .1452 square inch.
Contraction of area, 41.9 per cent.
Fractured, ".75 from the neck. Appearance, fine silky, cup-shaped.

No. 7512.

Metal from Nickel Steel Ingot. Natural state.
Marks, 322, N3-E.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 267.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0033	.0001	Elastic limit.
31,000	.0036	.....	
32,000	.0040	.....	
33,000	.0043	.....	
34,000	.0050	.....	
35,000	.0058	.0018	
36,000	.0067	.....	
37,000	.0077	.....	
38,000	.0093	.....	
39,000	.0120	.....	
40,000	.0168	.0119	
42,000	.0250	.....	
44,000	.0360	.....	
46,000	.0455	.....	
48,000	.0580	.....	
50,000	.0772	.0708	
52,000	.10	.....	
53,200	.....	.....	Tensile strength.
0	.16	.....	=5.8 per cent.

Elongation of inch sections: ".10*, ".03, ".03.
Diameter at fracture, ".53; area, .2206 square inch.
Contraction of area, 11.8 per cent.
Fractured ".9 from the neck. Appearance, 40 per cent granular with lustrous facets; 60 per cent dull amorphous.

No. 7513.

Metal from Carbon Steel Ingot. Natural state.
Marks, 323, C3-E.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 268.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	0.	
15,000	.0015	0.	Elastic limit.
16,000	.0021	.....	
17,000	.0035	.....	
18,000	.0053	.....	
19,000	.0063	.....	
20,000	.0090	.0067	
21,000	.0109	.....	
22,000	.0147	.....	
23,000	.0172	.....	
24,000	.0218	.....	
25,000	.0241	.0211	
26,000	.0290	.....	
28,000	.0372	.....	
30,000	.0485	.0448	
32,000	.06	.....	
34,000	.07	.....	
36,000	.09	.....	
38,000	.10	.....	
40,000	.12	.....	
42,000	.14	.....	
44,000	.17	.....	
46,000	.20	.....	
48,000	.24	.....	
50,000	.30	.....	
51,600	.....	.....	Tensile strength.
0	.40	.....	=13.3 per cent.

Elongation of inch sections: ".12, ".13, ".15*.
Diameter at fracture, ".52; area, .2124 square inch.
Contraction of area, 15 per cent.
Fractured 1".24 from the neck. Appearance, 40 per cent granular, 60 per cent irregular surface, amorphous.

No. 7514.

Bethlehem Steel. Annealed at high heat.
Marks, 324, 7×1, 3.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 268.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
40,000	.0041	0.	
45,000	.0046	0.	
50,000	.0051	0.	
51,000	.0053	.....	Elastic limit.
46,000	.0111	.....	
47,000	.0170	.....	
48,000	.0215	.....	
49,000	.0285	.....	
50,000	.0607	.0443	
52,000	.0682	.....	
56,000	.0930	.....	
58,000	.1073	.....	
60,000	.1218	.1139	
62,000	.15	.....	
64,000	.17	.....	
68,000	.22	.....	
72,000	.31	.....	
75,200	.....	.....	Tensile strength.
0	.81	.....	= 27 per cent.

Elongation of inch sections: ".13, ".19, ".49*.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured 1" from the neck. Appearance, fine silky, cup-shaped.

No. 7515.

Metal from Nickel Steel Ingot. Oil tempered and annealed.
Marks, 325, N3-D.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 269.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0008	0.	
10,000	.0010	0.	
15,000	.0015	0.	
20,000	.0020	0.	
25,000	.0026	0.	
30,000	.0031	0.	
35,000	.0036	0.	
40,000	.0042	0.	
45,000	.0047	0.	
50,000	.0052	0.	
55,000	.0058	0.	Elastic limit.
56,000	.0140	.....	
57,000	.0220	.....	
58,000	.0329	.....	
59,000	.0372	.....	
60,000	.0440	.0368	
62,000	.0480	.....	
64,000	.0657	.....	
68,000	.09	.....	
72,000	.13	.....	
76,000	.18	.....	
80,000	.29	.....	
80,800	.....	.....	Tensile strength.
0	.41	.....	=13.7 per cent.

Elongation of inch sections: ".16, ".10, ".15*.
Diameter at fracture, ".47; area, .1735 square inch.
Contraction of area, 30.6 per cent.
Fractured 1".5 from the neck. Appearance, dull amorphous, light and dark colored patches. Opened cracks in surface of stem.

No. 7564.

Metal from Carbon Steel Ingot. Oil tempered and annealed.
Marks, 327, C3-D.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 270.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	0.	
35,000	.0037	0.	
40,000	.0041	0.	
41,000	.0042	.....	Elastic limit.
42,000	.0045	.....	
43,000	.0048	.....	
44,000	.0370	.....	
45,000	.0376	.....	
46,000	.0400	.....	
47,000	.0440	.....	
48,000	.0480	.....	
49,000	.0532	.....	
50,000	.0580	.0512	
52,000	.07	.....	
56,000	.10	.....	
60,000	.12	.....	
64,000	.16	.....	
68,000	.24	.....	
69,680	.....	.....	Tensile strength.
0	.38	.....	=12.7 per cent.

Elongation of inch sections: ".13, ".16*, ".09.
Diameter at fracture, ".50; area, .1964 square inch.
Contraction of area, 21.4 per cent.
Fractured 1".3 from the neck. Appearance, dull gray, amorphous. Pitted surface. Opened cracks along surface of stem.

No. 7541.

Bethlehem Steel. Oil tempered and annealed at low heat.
Marks, 328, 7 × 2, 5.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see present Report, page 271.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0011	.....	
20,000	.0021	.....	
30,000	.0031	0.	
40,000	.0041	0.	
45,000	.0046	.....	
50,000	.0051	0.	
55,000	.0059	0.	
60,000	.0066	.0001	
65,000	.0073	.0003	Elastic limit.
68,000	.0082	.....	
69,000	.0087	.....	
70,000	.0110	.0033	
71,000	.0280	.....	
72,000	.0330	.....	
74,000	.0440	.....	
76,000	.0512	.....	
78,000	.0622	.....	
80,000	.0749	.0643	
84,000	.09	.....	
88,000	.13	.....	
92,000	.17	.....	
96,800	.22	.....	
100,000	.29	.....	
102,400	.....	.....	Tensile strength.
0	.81	.....	=27 per cent.

Elongation of inch sections: ″.17, ″.48*, ″.16.
Diameter at fracture, ″.35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured at the middle of the stem. Appearance, fine silky.

No. 7542.

Bethlehem Steel. Oil tempered and annealed at low heat.
Marks, 329, 7×1, 5.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 271.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0041	0.	
45,000	.0046	.....	
50,000	.0051	.0001	
54,000	.0058	.....	Elastic limit. Load fell.
50,000	.0300	.....	
51,000	.0370	.....	
52,000	.0395	.....	
53,000	.0432	.....	
54,000	.0492	.0426	
56,000	.0563	.....	
58,000	.0687	.....	
60,000	.0804	.0726	
64,000	.10	.....	
68,000	.13	.....	
72,000	.17	.....	
76,000	.22	.....	
80,000	.40	.....	
80,800	.....	.....	Tensile strength.
0	.87	.....	= 29 per cent.

Elongation of inch sections: ".18, ".52*, ".17.
Diameter at fracture, ".31; area, .0755 square inch.
Contraction of area, 69.8 per cent.
Fractured 1".8 from the neck. Appearance, fine silky.

No. 7543.

Bethlehem Steel. Annealed at low heat.
Marks, 330, 7×1, 2.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see present Report, page 272.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0003	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
35,000	.0036	.....	
40,000	.0041	.....	
45,000	.0046	.....	
50,000	.0052	0.	
55,000	.0058	0.	
57,000	.0060	.....	Elastic limit. Load fell.
52,000	.0132	.....	
53,000	.0144	.....	
54,000	.0250	.....	
55,000	.0328	.....	
56,000	.0362	.....	
58,000	.0450	.....	
60,000	.0761	.0682	
64,000	.09	.....	
68,000	.12	.....	
72,000	.15	.....	
76,000	.20	.....	
80,000	.28	.....	
82,600	.....	.....	Tensile strength.
0	.62	.....	=20.7 per cent.

Elongation of inch sections: ″.35*, ″.17, ″.10.
Diameter at fracture, ″.35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured, 1″.2 from the neck. Appearance, fine silky.

No. 7545.

Bethlehem Steel. Annealed at high heat.
Marks, 331, 7×1, 4.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 272.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0031	.....	
40,000	.0041	0.	
45,000	.0046	0.	
49,000	.0052	.....	Elastic limit. Load fell.
44,000	.0130	.....	
45,000	.0230	.....	
46,000	.0309	.....	
47,000	.0352	.....	
48,000	.0400	.....	
49,000	.0445	.....	
50,000	.0540	.0478	
52,000	.0715	.....	
54,000	.0810	.....	
56,000	.0940	.....	
58,000	.1065	.....	
60,000	.1290	.....	
64,000	.17	.....	
68,000	.22	.....	
72,000	.32	.....	
74,800	.....	.....	Tensile strength.
0	.83	.....	=27.7 per cent.

Elongation of inch sections: ".33*, ".37*, ".13.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured 1".47 from the neck. Appearance, fine silky.

No. 7565.

Bethlehem Steel. Oil tempered and annealed at low heat.
Marks, 332, 7×1, 6.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see present Report, page 273.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0021	.....	
30,000	.0032	.0001	
35,000	.0038	.....	
40,000	.0043	.0001	
45,000	.0049	.0001	
50,000	.0054	.0001	
55,000	.0059	.0001	Elastic limit. Load fell.
49,000	.0350	.....	
50,000	.0400	.....	
51,000	.0472	.....	
52,000	.0500	.....	
54,000	.0598	.....	
55,000	.0670	.0600	
60,000	.10	.....	
64,000	.13	.....	
68,000	.17	.....	
72,000	.23	.....	
76,000	.35	.....	
77,680	.....	.....	Tensile strength.
0	.90	.....	= 30 per cent.

Elongation of inch sections: ″.17, ″.49*, ″.24.
Diameter at fracture, ″.31; area, .0755 square inch.
Contraction of area, 69.8 per cent.
Fractured 1″.6 from the neck. Appearance, fine silky.

No. 7586.

Bethlehem Steel. Oil tempered and annealed at high heat.
Marks, 333, 7×1, 8.
Diameter, ".564.
Sectional area, .25 square inch.
Gauged length, 3".
For endurance test see present Report, page 273.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0010	.....	
20,000	.0020	.....	
30,000	.0031	.....	
40,000	.0042	0.	
45,000	.0048	0.	
50,000	.0056	0.	
55,000	.0061	0.	
60,000	.0068	0.	
62,000	.0069	.....	
63,000	.0070	.....	Elastic limit.
58,000	.0108	.....	Load fell.
59,000	.0140	.....	
60,000	.0440	.....	
62,000	.0510	.....	
64,000	.0580	.....	
66,000	.0665	.....	
68,000	.0770	.....	
70,000	.0849	.0752	
72,000	.0915	.....	
76,000	.13	.....	
80,000	.16	.....	
84,000	.21	.....	
88,000	.35	.....	
88,980	.....	.....	Tensile strength.
0	.74	.....	= 24.7 per cent.

Elongation of inch sections: ".14, ".44*, ".16.
Diameter at fracture, ".35; area, .0962 square inch.
Contraction of area, 61.5 per cent.
Fractured 1".6 from the neck. Appearance, fine silky, cup-shaped.

No 7587.

Bethlehem Steel. Annealed at high heat.
Marks, 336, 7×2, 3.
Diameter, ″.564.
Sectional area, .25 square inch.
Gauged length, 3″.
For endurance test see present Report, page 274.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0004	0.	
10,000	.0009	.....	
20,000	.0020	.....	
30,000	.0030	.....	
40,000	.0041	.0001	Elastic limit.
41,000	.0045	.....	
42,000	.0047	.....	
43,000	.0051	.....	
44,000	.0053	.....	
45,000	.0058	.0009	
46,000	.0064	.....	
47,000	.0070	.....	
48,000	.0080	.....	
49,000	.0091	.....	
50,000	.0120	.0062	
52,000	.0169	.....	
54,000	.0240	.....	
56,000	.0300	.....	
58,000	.0365	.....	
60,000	.0448	.0371	
64,000	.0605	.....	
68,000	.0690	.....	
72,000	.0780	.....	
76,000	.0972	.....	
80,000	.1470	.....	
84,000	.21	.....	
88,000	.28	.....	
91,280	.....	.....	Tensile strength.
0	.70	.....	= 23.3 per cent.

Elongation of inch sections: ″.13, ″.19, ″.38*.
Diameter at fracture, ″.40; area, .1257 square inch.
Contraction of area, 49.7 per cent.
Fractured 1″.1 from the neck. Appearance, fine silky, cup-shaped.

TABULATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS OF ROTATING SHAFTS.

Gauged length, 3″.

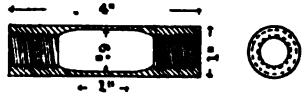
Tension test number.	Endurance test number.	Description.	Carbon.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3″.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Per ct.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
7492	280	Annealed	.26	.25	55,000	79,840	30.0	59.3	.18, .52*, .20	Fine silky.
7493	281	Oil hardened and annealed	.26	.25	64,000	89,680	25.3	61.5	.14, .19, .43*	Do.
7494	282	Annealed	.539	.25	54,000	111,200	35.7	57.0	.28, .29, .50*	Fine silky, serrated.
7495	283	Oil hardened and annealed	.539	.25	42,000	103,520	44.3	61.5	.33, .39, .61*	Fine silky.
7496	284	Annealed	.46	.25	49,000	94,080	25.0	44.6	.16, .40*, .19	Silky.
7497	285	Oil hardened and annealed	.46	.25	62,000	105,120	20.7	49.7	.13, .13, .36*	Silky, cup-shaped.
7498	286	Annealed	.42	.25	45,000	82,480	29.0	52.2	.20, .45*, .22	Silky.
7499	287	Oil hardened and annealed	.42	.25	55,000	90,000	25.0	59.3	.16, .22, .38*	Do.
7500	288	Annealed	.24	.25	41,000	70,880	38.0	61.5	.22, .55*, .22	Do.
7501	289	Oil hardened and annealed	.24	.25	44,000	72,080	30.7	69.8	.27, .49*, .16	Do.
7502	290	Annealed	.29	.25	78,000	108,000	19.0	57.0	.37*, .11, .09	Fine silky.
7503	291	Oil hardened and annealed	.29	.25	109,000	125,760	18.3	61.5	.35*, .12, .08	Fine silky, serrated.
7504	292	Annealed	.25	.25	62,000	92,880	25.0	57.0	.15, .25, .35*	Fine silky, cup-shaped.
7505	293	Oil hardened and annealed	.25	.25	101,000	116,800	19.0	59.3	.10, .17, .30*	Fine silky, serrated.
7506	294	Annealed	.66	.25	56,000	127,760	11.7	21.4	.08, .10, .17*	Granular; dull silky spot near center.
7507	295	Oil hardened and annealed	.66	.25	82,000	152,600	12.7	30.6	.08, .17*, .13*	Fine granular; dull silky spot at center.
7508	300	Rolled bar	.82	.25	66,000	147,600	9.0	8.4	.08, .11*, .08*	Fine granular.
7563	301	Treated bar	.....	.25	91,000	130,400	11.7	49.7	.04, .04, .27*	Fine silky, serrated.
7509	308	Rolled bar	1.09	.25	74,000	115,400	2.3	1.5	.02, .02, .03*	Fine granular.
7541	309	.....do	.73	.25	63,000	139,120	10.0	15.0	.13*, .10, .07	Do.
7510	310	.....do	.82	.25	67,000	147,600	9.0	11.8	.09, .10*, .08	Do.
7511	321	Annealed at low heat	.25	.25	65,000	104,800	16.3	41.9	.31*, .09, .09	Fine silky, cup-shaped.
7512	322	From nickel steel ingot, natural state	.17	.25	30,000	53,200	5.3	11.8	.10*, .03, .03	40 per cent granular with lustrous facets; 60 per cent dull amorphous.

TABULATION OF TENSION SPECIMENS FROM ENDS OF BARS RUPTURED BY ENDURANCE TESTS, ETC.—Continued.

Tension test number.	Endurance test number.	Description.	Carbon.	Sectional area.	Elastic limit per square inch.	Tensile strength per square inch.	Elongation in 3″.	Contraction of area.	Elongation of inch sections.	Appearance of fracture.
			Per ct.	*Sq. in.*	*Pounds.*	*Pounds.*	*Per ct.*	*Per ct.*	″ ″ ″	
7513	323	From carbon steel ingot, natural state	.20	.25	15,000	51,600	13.3	15.0	.12, .13, .15*	40 per cent granular; 60 per cent irregular surface, amorphous.
7514	324	Annealed at high heat	.26	.25	51,000	75,200	27.0	61.5	.13, .19, .49*	Fine silky, cup-shaped.
7515	325	From nickel steel ingot, oil tempered and annealed.	.17	.25	55,000	80,800	13.7	30.6	.16, .10, .15*	Dull amorphous; light and dark colored patches; opened cracks in surface of stem.
7564	327	From carbon steel ingot, oil tempered and annealed.	.20	.25	41,000	69,680	12.7	21.4	.13, .16*, .09	Dull gray, amorphous; pitted surface; opened cracks along surface of stem.
7541	328	Oil tempered and annealed at low heat	.25	.25	65,000	102,400	27.0	61.5	.17, .48*, .16	Fine silky.
7542	329	....do	.26	.25	54,000	80,800	29.0	69.8	.18, .52*, .17	Do.
7543	330	Annealed at low heat	.26	.25	57,000	82,600	20.7	61.5	.35*, .17, .10	Do.
7545	331	Annealed at high heat	.26	.25	49,000	74,800	27.7	61.5	.33*, .37*, .13	Do.
7565	332	Oil tempered and annealed at low heat	.26	.25	55,000	77,680	30.0	69.8	.17, .49*, .24	Do.
7586	333	Oil tempered and annealed at high heat	.26	.25	63,000	88,960	24.7	61.5	.14, .44*, .16	Fine silky, cup-shaped.
7587	336	Annealed at high heat	.25	.25	40,000	91,280	28.3	49.7	.13, .19, .38*	Do.

Annular Tensile Specimens from Ruptured Endurance Shafts.

The marks give the test number of the endurance shaft, also the figures and letters which were employed to identify the grade and treatment of the metal.



No. 7588.

Bethlehem Steel, Nickel. Annealed.
Specimen from end of shaft.
Marks, 280, 7 × 1 S.
Diameters, { exterior, 1".
interior, ".90.
Sectional area, .149 square inch.
Gauged length, 1".
For endurance test see Report of 1895, page 578.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0004	.....	
30,000	.0008	.....	
35,000	.0010	.....	
40,000	.0011	0.	
45,000	.0012	0.	
50,000	.0014	0.	
53,000	.0016	.....	Elastic limit.
	.0050	.....	
54,000	.0135	.....	
55,000	.0149	.....	
56,000	.0156	.....	
57,000	.0169	.....	
58,000	.0180	.....	
59,000	.0200	.....	
60,000	.0209	.....	
65,000	.0291	.....	
70,000	.0391	.0365	
86,440	.....	.....	Tensile strength.

Elongation of inch section: ".36.
Exterior diameter at fracture, ".80.
Appearance of fracture, silky.

No. 7591.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Specimen from middle of length of shaft.
Marks, 281, 7×1 HS.
Diameters { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 579.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0001	.....	
10,000	.0003	.....	
20,000	.0008	.....	
30,000	.0010	.....	
35,000	.0011	.....	
40,000	.0012	0.	
45,000	.0014	.....	
50,000	.0017	0.	
55,000	.0019	.....	
60,000	.0020	.0001	Elastic limit.
61,000	.0119	.....	
62,000	.0138	.....	
63,000	.0149	.....	
64,000	.0159	.....	
65,000	.0179	.0152	
66,000	.0194	.....	
68,000	.0218	.....	
70,000	.0250	.0219	
72,000	.0270	.....	
74,000	.0313	.....	
76,000	.0359	.....	
78,000	.0395	.....	
80,000	.0456	.0419	
92,210	.....	.....	Tensile strength.

Elongation of inch section: ″.31.
Exterior diameter at fracture, ″.82.
Appearance of fracture, silky.

No. 7592.

Bethlehem Steel. Oil hardened and annealed.
Specimen from end of shaft.
Marks, 285, 7×7 HS.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 589.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0005	.....	
30,000	.0009	.....	
35,000	.0011	.....	
40,000	.0012	0.	
45,000	.0013	.....	
50,000	.0015	0.	
55,000	.0017	.....	
60,000	.0019	0.	
63,000	.0021	.....	Elastic limit.
64,000	.0024	.....	
65,000	.0042	.....	
66,000	.0058	.....	
68,000	.0071	.....	
70,000	.0086	.0068	
72,000	.0099	.....	
74,000	.0111	.....	
76,000	.0132	.....	
78,000	.0143	.....	
80,000	.0162	.0129	
116,510	.....	.....	Tensile strength.

Elongation of inch section: ″.29.
Exterior diameter at fracture, ″.84.
Appearance of fracture, silky.

No. 7593.

Bethlehem Steel. Oil hardened and annealed.
Specimen from the middle of length of shaft.
Marks, 285, 7 × 7 HS.
Diameters { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 589.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0005	.....	
30,000	.0009	.....	
35,000	.0011	.....	
40,000	.0012	0.	
45,000	.0013	.....	
50,000	.0016	0.	
55,000	.0019	.....	
.....	.....	.....	Elastic limit about 58,000 pounds.
60,000	.0027	.0007	
61,000	.0031	.....	
62,000	.0033	.....	
63,000	.0039	.....	
64,000	.0046	.....	
66,000	.0058	.....	
68,000	.0072	.....	
70,000	.0086	.0059	
72,000	.0096	.....	
74,000	.0110	.....	
76,000	.0129	.....	
78,000	.0140	.....	
80,000	.0159	.0123	
115,440	.....	.....	Tensile strength.

Elongation of inch section: ″.29.
Exterior diameter at fracture, ″.84.
Appearance of fracture, silky.

No. 7594.

Bethlehem Steel. Annealed.
Specimen from end of shaft.
Marks, 286, 7×6 S.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 587.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0005	.....	
30,000	.0009	.....	
35,000	.0011	.....	
40,000	.0012	0.	
41,000	.0012	.....	Elastic limit.
42,000	.0020	.....	
43,000	.0090	.....	
44,000	.0093	.....	
45,000	.0098	.....	
46,000	.0106	.....	
47,000	.0114	.....	
48,000	.0125	.....	
49,000	.0136	.....	
50,000	.0147	.0126	
55,000	.0219	.....	
60,000	.0268	.0242	
65,000	.0352	.....	
70,000	.0480	.0448	
83,890	.....	.....	Tensile strength.

Elongation of inch section: ″.36.
Exterior diameter at fracture, ″.81.
Appearance of fracture, silky.

No. 7595.

Bethlehem Steel. Annealed.
Specimen from middle of length of shaft.
Marks, 286, 7×6 S.
Diameters { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 587.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0004	.....	
30,000	.0009	.....	
35,000	.0010	.....	
40,000	.0011	0.	
41,000	.0012	.....	Elastic limit.
42,000	.0017	.....	
43,000	.0019	.....	
44,000	.0021	.....	
45,000	.0026	.....	
46,000	.0032	.....	
47,000	.0038	.....	
48,000	.0042	.....	
49,000	.0053	.....	
50,000	.0060	.0041	
55,000	.0110	.....	
60,000	.0154	.0130	
65,000	.0215	.....	
70,000	.0297	.0263	
87,920	.....	.....	Tensile strength.

Elongation of inch section: ″.36.
Exterior diameter at fracture, ″.81.
Appearance of fracture, silky.

No. 7596.

Bethlehem Steel. Annealed.
Specimen from end of shaft.
Marks, 288, 7×5 S.
Diameters { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 586.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0002	.....	
20,000	.0006	.....	
30,000	.0010	.....	
35,000	.0011	.....	
.....	.....	.....	Elastic limit about 39,000 pounds.
40,000	.0023	.0011	
41,000	.0131	.....	
42,000	.0138	.....	
43,000	.0145	.....	
44,000	.0160	.....	
45,000	.0179	.0160	
46,000	.0187	.....	
47,000	.0210	.....	
48,000	.0219	.....	
49,000	.0231	.....	
50,000	.0247	.0227	
55,000	.0351	.....	
60,000	.0470	.....	
65,000	.0644	.....	
70,000	.1000	.....	
74,090	.....	.....	Tensile strength.

Elongation of inch section: ″.43.
Exterior diameter at fracture, ″.78.
Appearance of fracture, silky.

No. 7597.

Bethlehem Steel. Annealed.
Specimen from middle of length of shaft.
Marks, 288, 7×5 S.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 586.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0002	.....	
20,000	.0006	.....	
30,000	.0009	.....	
35,000	.0011	.....	
.....	.....	.....	Elastic limit about 39,000 lbs.
40,000	.0023	.0011	
41,000	.0030	.....	
42,000	.0038	.....	
43,000	.0041	.....	
44,000	.0051	.....	
45,000	.0058	.0039	
46,000	.0067	.....	
47,000	.0076	.....	
48,000	.0082	.....	
49,000	.0092	.....	
50,000	.0103	.0082	
55,000	.0163	.....	
60,000	.0229	.....	
65,000	.0351	.....	
70,000	.0528	.....	
77,580	.....	.....	Tensile strength.

Elongation of inch section: ″.39.
Exterior diameter at fracture, ″.79.
Appearance of fracture, silky.

No. 7554.

Bethlehem Steel. Oil hardened and annealed.
Specimen from end of shaft.
Marks, 289, 7×5 HS.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 586.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0004	.....	
30,000	.0008	.....	
35,000	.0010	.....	
40,000	.0012	0.	
41,000	.0014	.....	Elastic limit.
42,000	.0022	.....	
43,000	.0036	.....	
44,000	.0056	.....	
45,000	.0062	.....	
46,000	.0073	.....	
47,000	.0082	.....	
48,000	.0091	.....	
49,000	.0107	.....	
50,000	.0117	.0099	
55,000	.0182	.....	
60,000	.0270	.0248	
65,000	.0372	.....	
70,000	.0540	.....	
76,850	.....	.....	Tensile strength.

Elongation of inch section: ″.25.
Exterior diameter at fracture, ″.85.
Appearance of fracture, silky.

No. 7555.

Bethlehem Steel. Oil hardened and annealed.
Specimen from middle of length of shaft.
Marks, 289, 7×5 HS.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 586.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0004	.....	
30,000	.0008	.....	
35,000	.0010	.....	
40,000	.0011	0.	
42,000	.0012	.....	Elastic limit.
43,000	.0015	.....	
44,000	.0018	.....	
45,000	.0029	.....	
46,000	.0036	.....	
47,000	.0049	.....	
48,000	.0060	.....	
49,000	.0070	.....	
50,000	.0080	.0060	
55,000	.0147	.....	
60,000	.0229	.0203	
65,000	.0329	.....	
70,000	.0500	.....	
78,050	.....	.....	Tensile strength.

Elongation of inch section: ″.27.
Exterior diameter at fracture, ″.87.
Appearance of fracture, silky. There were numerous small cracks opened in the exterior surface ″.01 to ″.03 long in a circumferential direction, and ″.01± deep. Oblique fracture passing through three of these cracks.

No. 7556.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Specimen from end of shaft.
Marks, 291, 7×3 HS.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 583.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0002	.....	
20,000	.0006	.....	
30,000	.0009	.....	
35,000	.0010	.....	
40,000	.0012	0.	
45,000	.0014	.....	
50,000	.0015	.....	
55,000	.0017	.....	
60,000	.0019	0.	
70,000	.0021	0.	
80,000	.0024	0.	
90,000	.0027	0.	
100,000	.0030	0.	
107,000	.....	.....	Elastic limit.
108,000	.0032	.....	
109,000	.0040	.....	
110,000	.0048	.....	
111,000	.0064	.....	
112,000	.0110	.....	
129,060	.....	.....	Tensile strength.

Elongation of inch section: ″.25.
Exterior diameter at fracture, ″.85.
Appearance, silky.

No. 7557.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Specimen from middle of length of shaft.
Marks, 291, 7×3 HS.
Diameters { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 583.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0001	.....	
20,000	.0005	.....	
30,000	.0008	.....	
40,000	.0011	0.	
50,000	.0013	.....	
60,000	.0017	0.	
70,000	.0020	.....	
80,000	.0023	0.	
90,000	.0027	.....	
100,000	.0030	0.	
108,000	.0032	.....	Elastic limit.
109,000	.0038	.....	
110,000	.0057	.....	
111,000	.0130	.....	
112,000	.0166	.....	
128,190	.....	.....	Tensile strength.

Elongation of inch section: ″.22.
Exterior diameter at fracture, ″.89.
Appearance of fracture, silky. Small cracks opened in the outside surface of the specimen.

No. 7598.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Specimen from end of shaft.
Marks, 293, 7×2 HS.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 581.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0002	.....	
20,000	.0007	.....	
30,000	.0010	.....	
35,000	.0011	.....	
40,000	.0012	0.	
45,000	.0014	.....	
50,000	.0017	.....	
55,000	.0018	.....	
60,000	.0020	0.	
65,000	.0021	.....	
70,000	.0022	.....	
75,000	.0023	.....	
80,000	.0024	0.	
85,000	.0026	.....	
90,000	.0028	.....	
.....	.....	.....	Elastic limit, about 92,000 pounds.
95,000	.0052	.....	
100,000	.0248	.0204	
105,000	.0343	.....	
110,000	.0520	.....	
116,510	.....	.....	Tensile strength.

Elongation of inch section: ″.24.
Exterior diameter at fracture, ″.85.
Appearance of fracture, silky.

No. 7599.

Bethlehem Steel, Nickel. Oil hardened and annealed.
Specimen from middle of length of shaft.
Marks, 293, 7 × 2 HS.
Diameters { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 581.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	0.	.....	
10,000	.0002	.....	
20,000	.0006	.....	
30,000	.0009	.....	
35,000	.0010	.....	
40,000	.0011	0.	
45,000	.0013	.....	
50,000	.0016	.....	
55,000	.0018	.....	
60,000	.0019	0.	
65,000	.0021	.....	
70,000	.0022	.....	
75,000	.0023	.....	
80,000	.0025	0.	
85,000	.0027	.....	
90,000	.0030	.0001	Elastic limit.
91,000	.0056	.....	
92,000	.0061	.....	
93,000	.0067	.....	
94,000	.0071	.....	
95,000	.0090	.....	
100,000	.0242	.0203	
105,000	.0330	.....	
110,000	.0560	.....	
116,110	.....	.....	Tensile strength.

Elongation of inch section: ″.25.
Exterior diameter at fracture, ″.86.
Appearance of fracture, silky. A few minute circumferential cracks on the exterior surface opened near the place of rupture.

No. 7558.

Bethlehem Steel. Oil hardened and annealed.
Specimen from end of shaft.
Marks, 295, 7×8 HS.
Diameters, { exterior, 1″. interior, ″.90.
Sectional area, .149 square inch.
Gauged length, 1″.
For endurance test see Report of 1895, page 591.

Applied loads per square inch.	In gauged length.		Remarks.
	Elongation.	Set.	
Pounds.	*Inch.*	*Inch.*	
1,000	0.	0.	Initial load.
5,000	.0001	.....	
10,000	.0002	.....	
20,000	.0007	.....	
30,000	.0010	.....	
40,000	.0012	0.	
50,000	.0017	.....	
60,000	.0019	.....	
70,000	.0021	0.	
80,000	.0025	.....	
85,000	.0027	0.	
90,000	.0029	.0001	
94,000	.0032	.....	Elastic limit.
95,000	.0037	.....	
96,000	.0040	.....	
97,000	.0042	.....	
98,000	.0046	.....	
99,000	.0048	.....	
100,000	.0051	.0016	
101,000	.0054	.....	
102,000	.0058	.....	
103,000	.0060	.....	
104,000	.0062	.....	
105,000	.0067	.....	
106,000	.0070	.....	
107,000	.0072	.....	
108,000	.0078	.....	
109,000	.0082	.....	
110,000	.0085	.....	
111,000	.0090	.....	
112,000	.0093	.0049	
168,120	.....	.....	Tensile strength.

Elongation of inch section: ″.17.
Exterior diameter at fracture, ″.90.
Appearance of fracture, fine granular, in part silky.

BRICKS.

ABSORPTION OF WATER AND ELASTIC PROPERTIES.

DRY PRESSED AND MUD BRICKS FROM DIFFERENT PARTS OF A DOWN-DRAFT KILN.

The two kinds of bricks, made from the same clay, were burned side by side in the respective parts of the kiln mentioned.

MATERIAL FURNISHED BY MESSRS. FISKE & CO., BOSTON, MASS.

ABSORPTION TESTS OF BRICKS.

DRY PRESSED AND MUD BRICKS, FROM DIFFERENT PARTS OF THE SAME KILN, IMMERSED IN WATER DIFFERENT INTERVALS OF TIME AND THE TOTAL AND SUCCESSIVE AMOUNTS OF WATER ABSORBED DETERMINED.

Dry Pressed Brick, Top of Kiln.

Dimensions: 8″.18×4″.03×2″.42.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	40,950	.....	.....	.....
.....	.....	2	41,970	1,020	2.5	1,020
.....	.....	4	42,560	1,610	3.9	590
.....	.....	6	43,040	2,090	5.1	480
.....	.....	8	43,430	2,480	6.1	390
.....	.....	10	43,720	2,770	6.8	290
.....	.....	12	43,930	2,980	7.3	210
.....	.....	14	44,050	3,100	7.6	120
.....	.....	20	44,100	3,150	7.7	50
.....	1	.....	44,140	3,190	7.8	40
.....	10	.....	44,220	3,270	8.0	80
2	.....	.....	44,320	3,370	8.2	100
19	.....	.....	44,460	3,510	8.6	140
27	.....	.....	44,500	3,550	8.7	40
67	.....	.....	44,560	3,610	8.8	60
96	.....	.....	44,570	3,620	8.8	10
120	.....	.....	44,630	3,680	9.0	60
144	.....	.....	44,680	3,730	9.1	50
168	.....	.....	44,710	3,760	9.2	30

Dry Pressed Brick, One-third Down.

Dimensions: 8″.30×3″.92×2″.47.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	39,830	.....	.....	.....
.....	.....	2	40,985	1,155	2.9	1,155
.....	.....	4	41,710	1,880	4.7	725
.....	.....	6	42,225	2,395	6.0	515
.....	.....	8	42,640	2,810	7.1	415
.....	.....	10	42,980	3,150	7.9	340
.....	.....	12	43,200	3,370	8.5	220
.....	.....	14	43,340	3,510	8.8	140
.....	.....	20	43,440	3,610	9.1	100
.....	1	.....	43,580	3,750	9.4	140
.....	10	.....	43,670	3,840	9.6	90
2	.....	.....	43,820	3,990	10.0	150
4	.....	.....	43,810	3,980	10.0	−10
20	.....	.....	43,980	4,100	10.3	110
28	.....	.....	43,980	4,150	10.4	50
68	.....	.....	44,050	4,220	10.6	70
96	.....	.....	44,070	4,240	10.6	20
120	.....	.....	44,110	4,280	10.7	40
144	.....	.....	44,160	4,330	10.9	50
168	.....	.....	44,210	4,380	11.0	50

Dry Pressed Brick, Two-thirds Down.

Dimensions: 8″.42×4″×2″.50.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	41,800	.....	.....	.....
.....	.....	2	43,105	1,305	3.1	1,305
.....	.....	4	43,870	2,070	5.0	765
.....	.....	6	44,495	2,695	6.4	625
.....	.....	8	44,970	3,170	7.6	475
.....	.....	10	45,360	3,560	8.5	390
.....	.....	12	45,655	3,855	9.2	295
.....	.....	14	45,840	4,040	9.7	185
.....	.....	16	45,905	4,105	9.8	65
.....	.....	18	45,915	4,115	9.8	10
.....	.....	20	45,915	4,115	9.8	0
.....	10	.....	45,950	4,150	9.9	35
1	.....	.....	45,980	4,180	10.0	30
8	.....	.....	46,080	4,280	10.2	100
23	.....	.....	46,170	4,370	10.5	90
71	.....	.....	46,290	4,490	10.7	120
96	.....	.....	46,310	4,510	10.8	20
120	.....	.....	46,340	4,540	10.8	30
144	.....	.....	46,380	4,580	11.0	40
168	.....	.....	46,450	4,650	11.1	70

Dry Pressed Brick from Bottom of Kiln.

Dimensions: 8″.50×4″.05×2″.53.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	40,500	.....	.....	.....
.....	.....	2	41,935	1,435	3.5	1,435
.....	.....	4	42,880	2,380	5.9	945
.....	.....	6	43,710	3,210	7.9	830
.....	.....	8	44,390	3,890	9.6	680
.....	.....	10	44,950	4,450	11.0	560
.....	.....	12	45,450	4,950	12.2	500
.....	.....	14	45,780	5,280	13.0	330
.....	.....	16	46,005	5,505	13.6	225
.....	.....	18	46,110	5,610	13.8	105
.....	.....	20	46,110	5,610	13.8	0
.....	.....	30	46,115	5,615	13.9	5
.....	1	.....	46,130	5,630	13.9	15
.....	5	.....	46,130	5,630	13.9	0
.....	30	.....	46,130	5,630	13.9	0
3	.....	.....	46,150	5,650	14.0	20
15	.....	.....	46,215	5,715	14.1	65
26	.....	.....	46,260	5,760	14.2	45
42	.....	.....	46,370	5,870	14.5	110
66	.....	.....	46,440	5,940	14.7	70
114	.....	.....	46,520	6,020	14.9	80
120	.....	.....	46,530	6,030	14.9	10
144	.....	.....	46,530	6,030	14.9	0
168	.....	.....	46,580	6,080	15.0	50

Mud Brick, Top of Kiln.

Dimensions: 8″.05×3″.95×2″.40.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	43,990	.....	.....	.....
.....	.....	4	44,030	40	0.1	40
.....	.....	12	44,030	40	0.1	0
.....	1	.....	44,030	40	0.1	0
.....	5	.....	44,040	50	0.1	10
.....	30	.....	44,050	60	0.1	10
2	.....	.....	44,060	70	0.2	10
4	.....	.....	44,090	100	0.2	30
5	.....	.....	44,090	100	0.2	0
45	.....	.....	44,230	240	0.5	140
72	.....	.....	44,320	330	0.8	90
96	.....	.....	44,400	410	0.9	80
120	.....	.....	44,480	490	1.1	80
144	.....	.....	44,570	580	1.3	90
168	.....	.....	44,660	670	1.5	90

Mud Brick, One-Fourth Down.

Dimensions: 8″.10×3″.98×2″.38.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	42,290	.....	.....	.....
.....	.....	2	42,450	160	0.4	160
.....	.....	4	42,490	200	0.5	40
.....	.....	8	42,530	240	0.6	40
.....	.....	12	42,550	260	0.6	20
.....	.....	20	42,570	280	0.7	20
.....	1	.....	42,600	310	0.7	30
.....	5	.....	42,660	370	0.9	60
.....	10	.....	42,730	440	1.0	70
.....	30	.....	42,850	560	1.3	120
1	.....	.....	43,020	730	1.7	170
3	.....	.....	43,490	1,200	2.8	470
4	.....	.....	43,670	1,380	3.3	180
5	.....	.....	43,820	1,530	3.6	150
6	.....	.....	43,920	1,630	3.9	100
45	.....	.....	44,280	1,990	4.7	360
72	.....	.....	44,360	2,070	4.9	80
96	.....	.....	44,410	2,120	5.0	50
120	.....	.....	44,460	2,170	5.1	50
144	.....	.....	44,490	2,200	5.2	30
168	.....	.....	44,530	2,240	5.3	40

Mud Brick, Two-thirds Down.

Dimensions: 8″.42×4″.08×2″.52.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	45,020	.....	.....	.....
.....	.....	2	45,280	260	0.6	260
.....	.....	4	45,420	400	0.9	140
.....	.....	6	45,560	540	1.2	140
.....	.....	8	45,680	660	1.5	120
.....	.....	10	45,780	760	1.7	100
.....	.....	12	45,870	850	1.9	90
.....	.....	14	45,960	940	2.1	90
.....	.....	20	46,050	1,030	2.3	90
.....	.....	30	46,150	1,130	2.5	100
.....	1	.....	46,270	1,250	2.8	120
.....	2	.....	46,440	1,420	3.2	170
.....	3	.....	46,580	1,560	3.5	140
.....	4	.....	46,700	1,680	3.7	120
.....	5	.....	46,810	1,790	4.0	110
.....	7	.....	46,940	1,920	4.3	130
.....	10	.....	47,110	2,090	4.6	170
.....	15	.....	47,290	2,270	5.0	180
.....	20	.....	47,450	2,430	5.4	160
.....	25	.....	47,600	2,580	5.7	150
.....	30	.....	47,690	2,670	5.9	90
.....	45	.....	47,840	2,820	6.2	150
1	.....	.....	47,890	2,870	6.4	50
2	.....	.....	47,910	2,890	6.4	20
4	.....	.....	47,960	2,960	6.6	70
7	.....	.....	48,040	3,020	6.7	60
47	.....	.....	48,300	3,280	7.3	260
72	.....	.....	48,380	3,360	7.5	80
96	.....	.....	48,430	3,410	7.6	50
120	.....	.....	48,530	3,510	7.8	100
144	.....	.....	48,610	3,590	8.0	80
168	.....	.....	48,630	3,610	8.0	20

Mud Brick, Bottom of Kiln.

Dimensions: 8″.53×4″.16×2″.50.

Time in water.			Weight.	Gain.	Gain by weight.	Successive gain.
Hours.	*Mins.*	*Secs.*	*Grains.*	*Grains.*	*Per cent.*	*Grains.*
.....	.....	0	44,700	.....	.....	.....
.....	.....	2	45,120	420	0.9	420
.....	.....	4	45,440	740	1.7	320
.....	.....	6	45,670	970	2.2	230
.....	.....	8	45,880	1,180	2.6	210
.....	.....	10	46,060	1,360	3.0	180
.....	.....	12	46,220	1,520	3.4	160
.....	.....	14	46,400	1,700	3.8	180
.....	.....	20	46,600	1,900	4.3	200
.....	1	.....	46,890	2,190	4.9	290
.....	2	.....	47,370	2,670	6.0	480
.....	4	.....	47,710	3,010	6.7	340
.....	6	.....	47,940	3,240	7.2	230
.....	8	.....	48,160	3,460	7.7	220
.....	10	.....	48,320	3,620	8.1	160
.....	25	.....	48,540	3,840	8.6	220
1	.....	.....	48,600	3,900	8.7	60
2	.....	.....	48,630	3,930	8.8	30
17	.....	.....	48,910	4,210	9.4	280
25	.....	.....	49,050	4,350	9.7	140
64	.....	.....	49,150	4,450	10.0	100
88	.....	.....	49,210	4,510	10.1	60
96	.....	.....	49,250	4,550	10.2	40
120	.....	.....	49,310	4,610	10.3	60
144	.....	.....	49,400	4,700	10.5	90
168	.....	.....	49,430	4,730	10.6	30

Elastic Properties of Bricks.

Ends of bricks were ground flat on a rubbing bed.

No. 1458.

DRY PRESSED BRICK.

Shade 11, from top of kiln.
Total weight, 5 pounds 14½ ounces = 128.3 pounds per cubic foot.
Length, 8″.13.
Sectional area, 2″.43 × 4″.00 = 9.72 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
972	100	0.	0.	Initial load.
1,944	200	.0003	0.	
3,888	400	.0007	0.	
5,832	600	.0012	0.	
7,776	800	.0015	0.	
9,720	1,000	.0017	0.	
11,664	1,200	.0020	.....	
13,608	1,400	.0024	.....	
15,552	1,600	.0028	.....	
17,496	1,800	.0030	.....	
19,440	2,000	.0033	0.	
21,384	2,200	.0036	.....	
23,328	2,400	.0039	.....	
25,272	2,600	.0042	.....	
27,216	2,800	.0045	.....	
29,160	3,000	.0049	0.	E (1,000–3,000) = 3,125,000 pounds per square inch.
31,104	3,200	.0051	.....	
33,048	3,400	.0054	.....	
34,992	3,600	.0057	.....	
36,936	3,800	.0060	.....	
38,880	4,000	.0063	0.	
40,824	4,200	.0066	.....	
42,768	4,400	.0069	.....	
44,712	4,600	.0072	.....	
46,656	4,800	.0075	.....	
48,600	5,000	.0078	.0001	
50,544	5,200	.0081	.....	
52,488	5,400	.0084	.....	
54,432	5,600	.0087	.....	
56,376	5,800	.0090	.....	
58,320	6,000	.0093	.0001	
60,264	6,200	.0097	.....	
62,208	6,400	.0100	.....	
64,152	6,600	.0104	.....	
66,096	6,800	.0107	.....	
68,040	7,000	.0110	.0002	
69,984	7,200	.0113	.....	
71,928	7,400	.0117	.....	
73,872	7,600	.0120	.....	
75,816	7,800	.0124	.....	
77,760	8,000	.0127	.0008	E (1,000–8,000) = 3.271,000 pounds per square inch.
100,100	10,300	.....	.....	Ultimate strength.

No. 1459.

DRY PRESSED BRICK.

Shade 7, from $\frac{1}{8}$ down the kiln.
Total weight, 5 pounds $15\frac{3}{4}$ ounces = 127.2 pounds per cubic foot.
Length, 8″.23.
Sectional area, 2″.46 × 3″.98 = 9.79 square inches.
Gauged length, 5″.

Applied loads.		In gauged lengths.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
979	100	0.	0.	Initial load.
1,958	200	.0002	.....	
3,916	400	.0004	.....	
5,874	600	.0007	.....	
7,832	800	.0010	.....	
9,790	1,000	.0012	.0001	
11,748	1,200	.0015	.....	
13,706	1,400	.0018	.....	
15,664	1,600	.0021	.....	
17,622	1,800	.0025	.....	
19,580	2,000	.0029	.0001	
21,538	2,200	.0032	.....	
23,496	2,400	.0035	.....	
25,454	2,600	.0039	.....	
27,412	2,800	.0042	.....	
29,370	3,000	.0045	.0002	E (1,000–3,000) = 3,125,000 pounds per square inch.
31,328	3,200	.0048	.....	
33,286	3,400	.0052	.....	
35,244	3,600	.0055	.....	
37,202	3,800	.0058	.....	
39,160	4,000	.0061	.0002	
41,118	4,200	.0065	.....	
43,076	4,400	.0069	.....	
45,034	4,600	.0073	.....	
46,992	4,800	.0076	.....	
48,950	5,000	.0080	.0002	
50,908	5,200	.0083	.....	
52,866	5,400	.0086	.....	
54,824	5,600	.0091	.....	
56,782	5,800	.0094	.....	
58,740	6,000	.0097	.0004	
60,698	6,200	.0101	.....	
62,656	6,400	.0105	.....	
64,614	6,600	.0109	.....	
66,572	6,800	.0113	.....	
68,530	7,000	.0116	.0005	
70,488	7,200	.0121	.....	
72,446	7,400	.0125	.....	
74,404	7,600	.0129	.....	
76,362	7,800	.0134	.....	
78,320	8,000	.0140	.0006	E (1,000–8,000) = 2,846,000 pounds per square inch.
85,600	8,740	.....	.....	Ultimate strength.

No. 1460.

DRY PRESSED BRICK.

Shade 2, from ⅔ down the kiln.
Total weight, 5 pounds 13½ ounces = 124.3 pounds per cubic foot.
Length, 8″.24.
Sectional area, 2″.48 × 3″.95 = 9.8 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
980	100	0.	0.	Initial load.
1,960	200	.0003	0.	
3,920	400	.0008	0.	
5,880	600	.0012	0.	
7,840	800	.0017	0.	
9,800	1,000	.0022	.0001	
11,760	1,200	.0026	.....	
13,720	1,400	.0031	.....	
15,680	1,600	.0036	.....	
17,640	1,800	.0041	.....	
19,600	2,000	.0046	.0001	
21,560	2,200	.0050	.....	
23,520	2,400	.0055	.....	
25,480	2,600	.0059	.....	
27,440	2,800	.0064	.....	
29,400	3,000	.0068	.0002	E (1,000–3,000) = 2,222,000 pounds per square inch.
31,360	3,200	.0072	.....	
33,320	3,400	.0077	.....	
35,280	3,600	.0082	.....	
37,240	3,800	.0086	.....	
39,200	4,000	.0091	.0004	
41,160	4,200	.0096	.....	
43,120	4,400	.0101	.....	
45,080	4,600	.0107	.....	
47,040	4,800	.0112	.....	
49,000	5,000	.0118	.0005	E (1,000–5,000) = 2,174,000 pounds per square inch.
50,960	5,200	.0124	.....	
52,920	5,400	.0130	.....	
54,880	5,600	.0139	.....	
56,840	5,800	.0145	.....	
58,200	5,940	.....	.....	Ultimate strength.

No. 1461.

DRY DRESSED BRICK.

Shade 06, from bottom of kiln.
Total weight, 5 pounds 12 ounces=119.8 pounds per cubic foot.
Length, 8″.26.
Sectional area, 2″.51×4″.04=10.14 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,014	100	0.	0.	Initial load.
2,028	200	.0006	0.	
4,056	400	.0015	0.	
6,084	600	.0025	0.	
8,112	800	.0034	.0001	
10,140	1,000	.0041	.0002	
12,168	1,200	.0051	.....	
14,196	1,400	.0060	.....	
16,224	1,600	.0067	.....	
18,252	1,800	.0076	.....	
20,280	2,000	.0084	.0005	
22,308	2,200	.0093	.....	
24,336	2,400	.0101	.....	
26,364	2,600	.0111	.....	
28,392	2,800	.0121	.....	
30,420	3,000	.0131	.0009	E(1,000—3,000)=1,205,000 pounds per square inch.
32,448	3,200	.0146	.....	
34,476	3,400	.0165	.0015	
35,300	3,480	.....	.....	Ultimate strength.

No. 1462.

MUD BRICK.

Shade 8, from top of kiln.
Total weight, 6 pounds 1 ounce=144.3 pounds per cubic foot.
Length, 7″.89.
Sectional area, 2″.36×3″.90=9.20 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
920	100	0.	0.	Initial load.
1,840	200	0.	0.	
3,680	400	.0001	0.	
5,520	600	.0002	0.	
7,360	800	.0003	0.	
9,200	1,000	.0004	0.	
11,040	1,200	.0005	.....	
12,880	1,400	.0007	.....	
14,720	1,600	.0008	.....	
16,560	1,800	.0009	.....	
18,400	2,000	.0010	0.	
20,240	2,200	.0011	.....	
22,080	2,400	.0012	.....	
23,920	2,600	.0013	.....	
25,760	2,800	.0014	.....	
27,600	3,000	.0015	.0001	E (1,000-3,000)=10,000,000 pounds per square inch.
29,440	3,200	.0016	.....	
31,280	3,400	.0017	.....	
33,120	3,600	.0018	.....	
34,960	3,800	.0019	.....	
36,800	4,000	.0020	.0001	
38,640	4,200	.0021	.....	
40,480	4,400	.0023	.....	
42,320	4,600	.0024	.....	
44,160	4,800	.0025	.....	
46,000	5,000	.0026	.0001	
49,680	5,400	.0029	.....	
53,360	5,800	.0030	.....	
55,200	6,000	.0031	.0001	
58,880	6,400	.0034	.....	
62,560	6,800	.0036	.....	
64,400	7,000	.0038	.0001	
68,080	7,400	.0040	.....	
71,760	7,800	.0042	.....	
73,600	8,000	.0044	.0001	
77,280	8,400	.0046	.....	
80,960	8,800	.0049	.....	
82,800	9,000	.0051	.0001	
86,480	9,400	.0053	.....	
90,160	9,800	.0056	.....	
92,000	10,000	.0057	.0001	E (1,000-10,000)=8,654,000 pounds per square inch.
176,400	19,170	.....	.....	Ultimate strength.

No. 1463.

MUD BRICK.

Shade 5, from ¼ down the kiln.
Total weight, 6 pounds=136.4 pounds per cubic foot.
Length, 8″.04.
Sectional area, 2″.35×3″.99=9.38 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
938	100	0.	0.	Initial load.
1,876	200	.0001	0.	
3,752	400	.0003	0.	
5,628	600	.0004	0.	
7,504	800	.0005	0.	
9,380	1,000	.0006	0.	
11,256	1,200	.0007	.....	
13,132	1,400	.0009	.....	
15,008	1,600	.0010	.....	
16,884	1,800	.0011	.....	
18,760	2,000	.0012	0.	
22,512	2,400	.0015	.....	
26,264	2,800	.0017	.....	
28,140	3,000	.0019	0.	E (1,000–3,000)=7,692,000 pounds per square inch.
31,892	3,400	.0021	.....	
35,644	3,800	.0024	.....	
37,520	4,000	.0026	0.	
41,272	4,400	.0028	.....	
45,024	4,800	.0031	.....	
46,900	5,000	.0033	.0001	
50,652	5,400	.0035	.....	
54,404	5,800	.0038	.....	
56,280	6,000	.0040	.0001	E (1,000–6,000)=7,576,000 pounds per square inch.
60,032	6,400	.0042	.....	Snapping sounds.
63,784	6,800	.....	.....	Spawled at lower edge.
147,000	15,670	.....	.....	Ultimate strength.

No. 1464.

MUD BRICK.

Shade 2, from ⅜ down the kiln.
Total weight, 6 pounds 4¼ ounces=130.6 pounds per cubic foot.
Length, 8″.30.
Sectional area, 2″.48×4″.07=10.09 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
1,009	100	0.	0.	Initial load.
2,018	200	0.	0.	
4,036	400	.0001	0.	
6,054	600	.0003	0.	
8,072	800	.0006	0.	
10,090	1,000	.0008	0.	
12,108	1,200	.0010	.....	
14,126	1,400	.0012	.....	
16,144	1,600	.0014	.....	
18,162	1,800	.0016	.....	
20,180	2,000	.0019	.0001	
24,216	2,400	.0022	.....	
28,252	2,800	.0027	.....	
30,270	3,000	.0029	.0002	E (1,000-3,000) = 5,263,000 pounds per square inch.
34,306	3,400	.0034	.....	Snapping sounds.
38,342	3,800	.0039	.....	Corner spawled off.
40,360	4,000	.0042	.0002	
44,396	4,400	.0045	.....	
48,432	4,800	.0050	.....	
50,450	5,000	.0052	.0002	
54,486	5,400	.0056	.....	
58,522	5,800	.0061	.....	
60,540	6,000	.0063	.0002	
64,576	6,400	.0068	.....	
68,612	6,800	.0073	.....	
70,630	7,000	.0076	.0002	E (1,000-7,000) = 4,545,000 pounds per square inch.
105,100	10,420	.....	.....	Ultimate strength.

No. 1465.

MUD BRICK.

Shade 03, from bottom of kiln.
Total weight, 6 pounds 4¼ ounces = 125.4 pounds per cubic foot.
Length, 8″.26.
Sectional area: 2″.51 × 4″.15 = 10.42 square inches.
Gauged length, 5″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	Initial load.
1,042	100	0.	0.	
2,084	200	.0001	0.	
4,168	400	.0002	0.	
6,252	600	.0004	0.	
8,336	800	.0007	0.	
10,420	1,000	.0009	0.	
12,504	1,200	.0010	.....	
14,588	1,400	.0012	.....	
16,672	1,600	.0015	.....	
18,756	1,800	.0017	.....	
20,840	2,000	.0019	0.	
25,008	2,400	.0023	.....	
29,176	2,800	.0029	.....	
31,260	3,000	.0031	0.	E (1,000–3,000) = 4,545,000 pounds per square inch.
35,428	3,400	.0036	.....	
39,596	3,800	.0041	.....	
41,680	4,000	.0044	0.	
45,848	4,400	.0049	.....	
50,016	4,800	.0054	.....	
52,100	5,000	.0057	0.	
56,268	5,400	.0062	.....	
60,436	5,800	.0068	.....	
62,520	6,000	.0070	0.	
66,688	6,400	.0075	.....	
70,856	6,800	.0080	.....	
72,940	7,000	.0084	.0001	
77,108	7,400	.0089	.....	
81,276	7,800	.0094	.....	
83,360	8,000	.0098	.0001	E (1,000–8,000) = 3,977,000 pounds per square inch.
113,300	10,870	.....	.....	Ultimate strength.

TABULATION OF TESTS ON ELASTIC PROPERTIES AND COMPRESSIVE STRENGTH OF DRY-PRESSED AND MUD BRICKS.

Gauged length, 5″.

No. of test.	Kind of brick.	Shade.	Position in kiln.	Weight per cubic foot.	Modulus of elasticity.		Permanent sets after loads per square inch of—			Compressive strength per square inch.	Remarks.
					Between loads per square inch of 1,000 and 3,000.	At highest stress observed.	1,000.	3,000.	5,000.		
				Pounds.	*Pounds.*	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	*Pounds.*	
1458	Dry pressed ..	11	Top.....	128.3	3,125,000	3,271,000	0.	0.	.0001	10,300	The several bricks were loaded endwise.
1459	.....do.....	7	¼ down	127.2	3,125,000	2,846,000	.0001	.0002	.0002	8,740	
1460	.....do.....	2	½ down	124.3	2,222,000	2,174,000	.0001	.0002	.0005	5,940	
1461	.....do.....	06	Bottom.....	119.8	1,205,000	.....	.0002	.0009	.....	3,480	
1462	Mud.....	8	Top.....	144.3	10,000,000	8,654,000	0.	.0001	.0001	19,170	
1463	.....do.....	5	¼ down	136.4	7,692,000	7,576,000	0.	0.	.0001	15,670	
1464	.....do.....	2	½ down	130.6	5,263,000	4,545,000	0.	.0002	.0002	10,420	
1465	.....do.....	03	Bottom.....	125.4	4,545,000	3,977,000	0.	0.	0.	10,870	

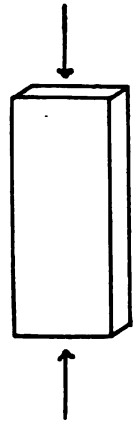
SLATE—SLABS, CUBES, AND ROOFING.

MATERIAL FURNISHED BY THE MATHEWS CONSOLIDATED SLATE COMPANY, BOSTON, MASS.

Chemical analyses.

Marks.	Color.	Silica.	Oxide of iron.	Alumina.	Lime.	Oxide of magnesium.	Carbon dioxide.
1.....	Purple.....	61.75	7.05	18.81	2.00	3.05	7.34
2.....	Green	61.61	6.70	19.56	2.33	3.85	5.95
3.....	Red	70.20	4.36	17.65	Trace.	Trace.	3.22
4.....	Red	67.00	3.97	24.23	Trace.	2.05	3.43
5.....	Green	60.12	8.00	25.74	Trace.	2.75	3.39

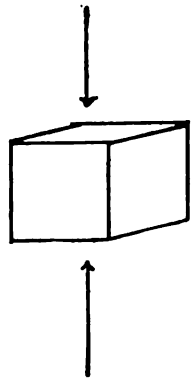
Compression Tests of Slabs.



No. of test.	Marks.	Color.	Dimensions.			Sectional area.	Ultimate strength.		Fracture.
			Height.	Compressed surface.			Total.	Per square inch.	
			Inches.	*Inches.*	*Ins.*	*Sq. ins.*	*Pounds.*	*Pounds.*	
12,011	2 B	Green .	30.05	12.00	2.02	24.24	429,000	17,700	Crushed at one end and split longitudinally.
12,012	2 B	....do ..	30.05	11.99	2.02	24.22	168,000	6,940	Split along a false joint at middle of height.
12,013	2 B	....do ..	30.00	12.00	1.98	23.76	389,000	16,370	Crushed at one end.
12,014	7 C	Purple.	30.05	12.01	1.98	23.78	255,800	10,760	Crushed at one end and split longitudinally.
12,015	7 C	....do ..	30.05	12.00	2.00	24.00	279,000	11,630	Do.
12,016	7 C	....do ..	30.03	12.01	2.01	24.14	340,500	14,110	Crushed at middle of height.
12,017	6 B	Red ...	30.05	11.99	1.93	23.14	306,000	13,220	Crushed near end, split longitudinally.
12,018	6 B	....do ..	30.05	12.00	1.97	23.64	205,000	8,670	Crushed at end, split longitudinally.
12,019	6 B	....do ..	30.05	12.00	1.96	23.52	265,400	11,280	Crushed at end and split longitudinally. Oblique crack near middle.

Test No. 12020.

Compression Tests of Cubes.



Marks.	Color.	How tested.	Dimensions.			Sectional area.	Ultimate strength.	
			Height.	Compressed surface.			Total.	Per square inch.
			Inches.	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*
1A	Purple.....	On bed	3.99	4.00	4.00	16.00	421,000	26,310
1A	.....do.....	.....do.....	3.96	4.00	3.95	15.80	440,000	27,850
1A	.....do.....	.....do.....	4.00	3.97	4.00	15.88	453,000	28,530
1A	.....do.....	On edge	3.99	3.96	3.99	15.80	494,000	31,270
1A	.....do.....	.....do.....	4.00	3.99	3.99	15.92	504,000	31,660
1A	.....do.....	.....do.....	3.98	3.95	4.00	15.80	432,000	27,970
2A	Green	On bed	4.10	4.00	4.01	16.04	395,800	24,680
2A	.....do.....	.....do.....	4.09	4.01	4.00	16.04	353,000	22,010
2A	.....do.....	.....do.....	4.07	4.00	4.00	16.00	374,600	23,410
2A	.....do.....	On edge	3.97	4.00	4.07	16.28	409,000	25,120
2A	.....do.....	.....do.....	3.99	4.00	4.06	16.24	400,500	24,660
2A[a]	.....do.....	.....do.....	3.98	4.00	4.05	16.20	327,000	20,190
3A	Red	On bed	4.05	3.80	3.99	15.16	421,500	27,800
3A	.....do.....	.....do.....	4.03	3.96	3.97	15.72	455,000	28,940
3A	.....do.....	.....do.....	4.09	4.02	4.01	16.12	474,000	29,400
3A	.....do.....	On edge	4.15	4.03	4.00	16.12	255,000	15,820
3A	.....do.....	.....do.....	4.01	4.03	4.07	16.40	269,900	16,460
3A	.....do.....	.....do.....	4.12	4.01	4.00	16.04	259,500	16,180
5A	Green	On bed	4.00	4.00	4.00	16.00	319,000	19,940
5A	.....do.....	.....do.....	3.99	4.00	4.00	16.00	343,800	21,490
5A	.....do.....	.....do.....	3.99	4.00	4.00	16.00	320,500	20,030
5A	.....do.....	On edge	4.00	4.02	3.99	16.04	227,500	14,180
5A	.....do.....	.....do.....	4.00	4.00	4.00	16.00	299,600	18,730
5A	.....do.....	.....do.....	4.00	4.00	4.03	16.12	270,000	16,750
6A	Red	On bed	4.00	4.00	4.01	16.04	439,500	27,400
6A	.....do.....	.....do.....	3.98	4.00	4.00	16.00	382,800	23,930
6A	.....do.....	.....do.....	3.97	4.00	4.01	16.04	421,000	26,250
6A	.....do.....	On edge	4.00	4.02	3.97	15.96	384,000	20,930
6A	.....do.....	.....do.....	4.01	4.02	3.98	16.00	349,500	21,840
6A	.....do.....	.....do.....	4.00	4.01	3.95	15.84	369,000	23,300

[a] Compressed surface not flat.

FRACTURED CUBES OF SLATE AFTER COMPRESSION TESTS, SHOWING THE MANNER OF FAILURE WHEN LOADED ON EDGE AND ON BED, RESPECTIVELY. ARROWS SHOW THE DIRECTION OF LOADING.

HELIOTYPE CO., BOSTON.

Details of Transverse Tests.

GREEN TREAD, 2C, FIRST SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
100	.....	.012	
150	.....	.024	
200	.....	.036	
250	.....	.048	
50	.....	0.	
300	.....	.060	
350	.....	.072	
400	.....	.084	
450	.....	.097	
50	.....	0.	
[illegible]	.....	.109	
[illegible]	.....	.120	
[illegible]	.....	.132	
[illegible]	.....	.146	
[illegible]	.....	0.	
[illegible]	.....	.159	
[illegible]	.....	.170	
[illegible]	.....	.182	
[illegible]	.....	.194	
[illegible]	.....	0.	
[illegible]	.....	.207	
[illegible]	.....	.218	
1,000	.....	.230	
1,050	.....	.244	
[illegible]	.....	.....	
1,100	7,425	.....	Ultimate strength.

GREEN TREAD, 2C, SECOND SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
[illegible]	.....	0.	Initial load.
[illegible]	.....	.055	
[illegible]	.....	.111	
[illegible]	.....	.162	
[illegible]	.....	.224	
[illegible]	.....	[illegible]	
[illegible]	.....	[illegible]	
[illegible]	.....	[illegible]

Details of Transverse Tests—Continued.

GREEN TREAD, 2C, THIRD SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.049	
50	.....	0.	
450	.....	.090	
50	.....	0.	
650	.....	.131	
50	.....	0.	
850	.....	.171	
50	.....	0.	
1,060	.....	.214	
50	.....	.....	
1,250	.....	.256	
50	.....	.....	
1,450	.....	.296	
50	.....	.....	
1,650	10,100	.....	Ultimate strength. Sustained the maximum load 4 minutes, then fractured.

RED TREAD, 6D, FIRST SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
	unds.	*Inch.*	
	.....	0.	Initial load.
	.....	.042	
	.....	0.	
	.....	.084	
	.....	0.	
	.....	.125	
	.....	0.	
	.....	.168	
	.....	0.	
	.....	.....	Ultimate strength.

ED TREAD, 6D, SECOND SAMPLE.

A			
Total.			Remarks.
Pounds.			
50	.....		
250	.....		
50	.....		
450	.....		
50	.....		
650	.....		
50	.....		
850	.....		
50	.....		
1,050	.....		
50	.....		
1,250	.....		
50	.....		
1,364	8,190	...	

Details of Transverse Tests.

GREEN TREAD, 2C, FIRST SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
100	.....	.012	
150	.....	.024	
200	.....	.036	
250	.....	.048	
50	.....	0.	
300	.....	.060	
350	.....	.072	
400	.....	.084	
450	.....	.097	
50	.....	0.	
500	.....	.109	
550	.....	.120	
600	.....	.132	
650	.....	.146	
50	.....	0.	
700	.....	.159	
750	.....	.170	
800	.....	.182	
850	.....	.194	
50	.....	0.	
900	.....	.207	
950	.....	.218	
1,000	.....	.230	
1,050	.....	.244	
50	.....	.....	
1,100	7,425	.....	Ultimate strength.

GREEN TREAD, 2C, SECOND SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.055	
50	.....	0.	
450	.....	.111	
50	.....	0.	
650	.....	.162	
50	.....	0.	
850	.....	.214	
50	.....	0.	
1,050	.....	.263	
50	.....	0.	
1,250	.....	.310	
1,450	.....	.365	
1,630	11,230	.....	Ultimate strength.

Details of Transverse Tests—Continued.

GREEN TREAD, 2C, THIRD SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.049	
50	.....	0.	
450	.....	.090	
50	.....	0.	
650	.....	.131	
50	.....	0.	
850	.....	.171	
50	.....	0.	
1,060	.....	.214	
50	.....	.....	
1,250	.....	.255	
50	.....	.....	
1,450	.....	.296	
50	.....	.....	
1,650	10,100	.....	Ultimate strength. Sustained the maximum load 4 minutes, then fractured.

RED TREAD, 6D, FIRST SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.042	
50	.....	0.	
450	.....	.084	
50	.....	0.	
650	.....	.125	
50	.....	0.	
850	.....	.168	
50	.....	0.	
1,080	6,430	.....	Ultimate strength.

RED TREAD, 6D, SECOND SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.040	
50	.....	0.	
450	.....	.079	
50	.....	0.	
650	.....	.118	
50	.....	0.	
850	.....	.156	
50	.....	0.	
1,060	.....	.194	
50	.....	0.	
1,250	.....	.232	
50	.....	0.	
1,364	8,190	.....	Ultimate strength.

Details of Transverse Tests—Continued.

RED TREAD, 6D, THIRD SAMPLE.

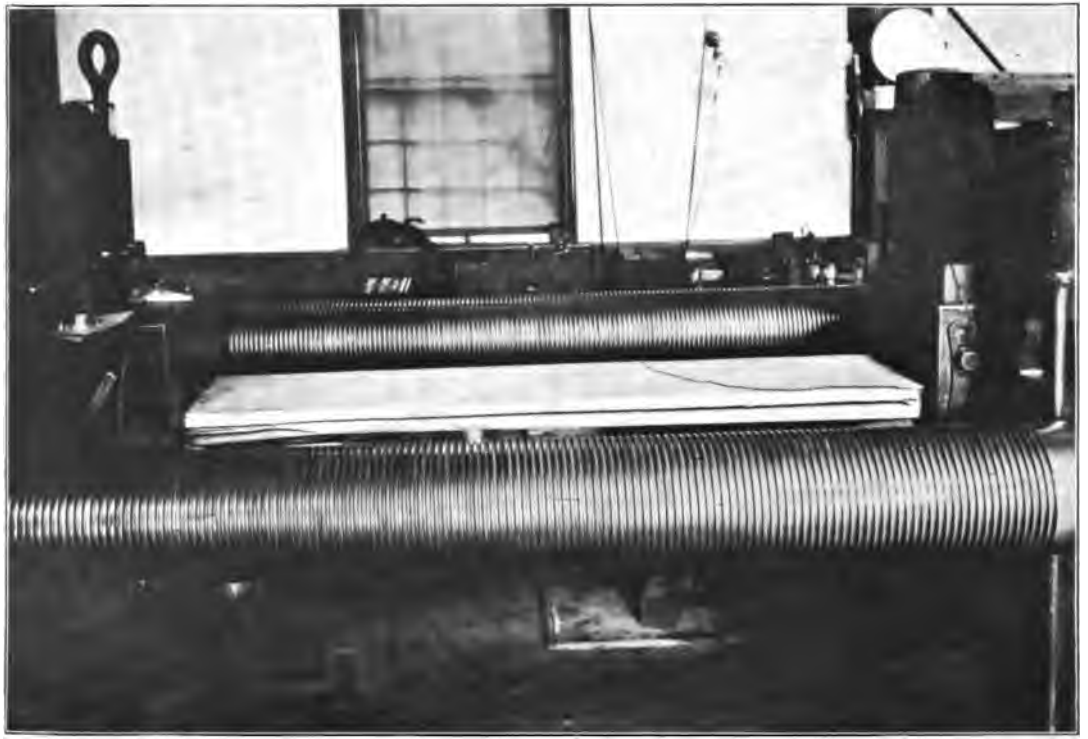
Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.040	
50	.....	0.	
450	.....	.081	
50	.....	0.	
650	.....	.123	
50	.....	.....	
850	.....	.165	
50	.....	.....	
1,050	.....	.209	
50	.....	0.	
1,250	.....	.262	
50	.....	.....	
1,435	9,140	.....	Ultimate strength.

PURPLE TREAD, 7D, FIRST SAMPLE.

Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.046	
50	.....	.....	
450	.....	.087	
50	.....	.....	
650	.....	.127	
50	.....	.....	
850	.....	.167	
50	.....	.....	
1,050	.....	.210	
50	.....	.....	
1,250	.....	.253	
50	.....	.....	
1,450	.....	.295	
50	.....	0.	
1,556	9,530	.....	Ultimate strength.

PURPLE TREAD, 7D, SECOND SAMPLE.

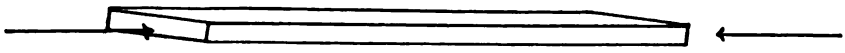
Applied loads.		Deflections.	Remarks.
Total.	Modulus of rupture per square inch.		
Pounds.	*Pounds.*	*Inch.*	
50	.....	0.	Initial load.
250	.....	.052	
50	.....	0.	
450	.....	.103	
50	.....	0.	
650	.....	.154	
50	.....	0.	
850	.....	.205	
50	.....	0.	
1,050	6,300	.....	Ultimate strength.



PHOTOGRAPH OF SLAB MARKED 2C, AFTER FRACTURE. CRUSHING STRENGTH, 9,260 POUNDS PER SQUARE INCH.

Test No. 12023.

Compression Tests of Slabs.



GREEN SLAB.

Marks, 2D.
Dimensions, 12″.01×1″.96×60″.
Sectional area, 23.54 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,354	100	0.	0.	Initial load.
4,708	200	.0002	.....	
9,416	400	.0007	.....	
14,124	600	.0012	.....	
18,832	800	.0017	.....	
23,540	1,000	.0023	0.	
47,080	2,000	.0044	0.	
70,620	3,000	.0065	0.	
94,160	4,000	.0088	0.	
117,700	5,000	.0109	0.	Opened seam along cleavage planes near one end of slab. E (1,000–5,000)=13,953,000 pounds per square inch.
190,800	8,110	.....	.....	Ultimate strength.

Seams at end gradually opened, finally splitting longitudinally the full length of the slab.

GREEN SLAB.

Marks, 2C.
Dimensions, 12″.01×1″.97×60″.
Sectional area, 23.66 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,366	100	0.	0.	Initial load.
4,732	200	.0002	.....	
9,464	400	.0007	.....	
14,196	600	.0012	.....	
18,928	800	.0017	.....	
23,660	1,000	.0022	0.	
47,320	2,000	.0043	0.	
70,980	3,000	.0064	0.	
94,640	4,000	.0085	0.	
118,300	5,000	.0107	.0001	Opened seam at one end along cleavage planes. E (1,000–5,000)=14,286,000 pounds per square inch.
219,000	9,260	.....	.....	Ultimate strength.

Crushed at ends and split longitudinally from end to end.

GREEN SLAB.

Marks, 2C.
Dimensions, 12″×1″.98×60″.
Sectional area, 23.76 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,376	100	0.	0.	Initial load.
4,752	200	.0008	.....	
9,504	400	.0008	.....	
14,256	600	.0014	.....	
19,008	800	.0019	.....	
23,760	1,000	.0023	0.	
47,520	2,000	.0043	0.	
71,280	3,000	.0063	0.	
95,040	4,000	.0083	0.	Crack opened near end of slab.
				E (1,000–4,000) = 15,000,000 pounds per square inch.
205,000	8,630	.....	.....	Ultimate strength.

RED SLAB.

Marks, 6D.
Dimensions, 12″×2″.04×60″.03.
Sectional area, 24.48 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,448	100	0.	0.	Initial load.
4,896	200	.0001	.....	
9,792	400	.0004	.....	
14,688	600	.0007	.....	
19,584	800	.0010	.....	
24,480	1,000	.0013	0.	
48,960	2,000	.0030	0.	
73,440	3,000	.0049	0.	
97,920	4,000	.0066	0.	
122,400	5,000	.0085	0.	
146,880	6,000	.0105	0.	
171,360	7,000	.0124	0.	E (1,000–7,000) = 16,216,000 pounds per square inch.
267,000	10,910	.....	.....	Ultimate strength.

RED SLAB.

Marks, 6C.
Dimensions, 12″×1″.99×60″.05.
Sectional area, 23.88 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,388	100	0.	0.	Initial load.
4,776	200	.0001	.....	
9,552	400	.0005	.....	
14,328	600	.0010	.....	
19,104	800	.0014	.....	
23,880	1,000	.0020	0.	
47,760	2,000	.0040	0.	
71,640	3,000	.0060	0.	
95,520	4,000	.0080	.0001	
119,400	5,000	.0101	.0001	
143,280	6,000	.0128	.0005	E (1,000–6,000)=14,563,000 pounds per square inch.
150,000	6,280	.....	.....	Longitudinal seams opened.
219,000	9,170	.....	.....	Ultimate strength.

Sustained the maximum load 3 minutes and then fractured by crushing at a place 16 inches from the end of the slab, and splitting longitudinally.

RED SLAB.

Marks, 6C.
Dimensions, 12″×1″.95×60″.
Sectional area, 23.40 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,340	100	0.	0.	Initial load.
4,680	200	.0002	.....	
9,360	400	.0006	.....	
14,040	600	.0010	.....	
18,720	800	.0015	.....	
23,400	1,000	.0019	0.	
46,800	2,000	.0088	0.	
70,200	3,000	.0067	.0001	
93,600	4,000	.0077	.0001	Longitudinal seam opened.
117,000	5,000	.0105	.0001	E (1,000–5,000)=14,118,000 pounds per square inch.
135,800	5,800	.....	.....	Ultimate strength.

Crushed at one end and split longitudinally.

PURPLE SLAB.

Marks, 7C.
Dimensions, 12″.01×2″×60″.05.
Sectional area, 24.02 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,402	100	0.	0.	Initial load.
4,804	200	.0002	.....	
9,608	400	.0005	.....	
14,412	600	.0009	.....	
19,216	800	.0013	.....	
24,020	1,000	.0015	0.	
48,040	2,000	.0035	0.	
72,060	3,000	.0054	.0002	
96,080	4,000	.0072	.0008	Opened longitudinal crack.
				E (1,000–4,000) = 16,667,000 pounds per square inch.
229,100	9,540	.....	.....	Ultimate strength.

PURPLE SLAB.

Marks, 7C.
Dimensions, 12″×2″.03×60″.04.
Sectional area, 24.36 square inches.
Gauged length, 30″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,436	100	0.	0.	Initial load.
4,872	200	.0003	.....	
9,744	400	.0007	.....	
14,616	600	.0013	.....	
19,488	800	.0015	.....	
24,360	1,000	.0019	.0005	
48,720	2,000	.0035	.0005	
73,080	3,000	.0056	.0011	E (1,000–3,000) = 19,355,000 pounds per square inch.
97,440	4,000	.0073	.0015	
121,800	5,000	.0100	.0010	
237,000	9,730	.....	.....	Ultimate strength.

CEMENT.

CEMENT.

COMPRESSION TESTS OF 4-INCH CUBES OF DIFFERENT BRANDS OF NEAT CEMENT.

ALPHA CEMENT, NEAT.

Water used in mixing, 25 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Mos.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.10	4.01	3.92	15.72	87,800	89,700	5,706	.....
7	.....	4.00	4.03	3.97	16.00	91,000	93,600	5,850	.....
7	.....	4.02	4.00	4.00	16.00	97,000	98,900	6,181	.....
7	.....	4.08	4.02	4.00	16.08	89,900	95,500	5,939	.....
7	.....	4.12	4.00	4.01	16.04	101,500	102,500	6,390	6,010
.....	1	4.00	4.04	4.00	16.16	.....	117,500	7,271	.....
.....	1	3.99	4.05	4.01	16.24	114,000	116,000	7,143	.....
.....	1	4.05	4.02	3.97	15.96	101,000	105,500	6,610	.....
.....	1	4.00	4.07	4.00	16.28	.....	123,000	7,555	.....
.....	1	4.08	3.98	4.00	15.92	.....	129,100	8,109	7,340
.....	3	4.05	3.98	4.00	15.92	.....	131,100	8,235	.....
.....	3	4.07	4.01	3.96	15.88	.....	143,200	9,018	.....
.....	3	4.01	3.99	4.00	15.96	.....	128,400	8,045	.....
.....	3	4.06	4.00	3.99	15.96	.....	143,700	9,004	8,580

ATLAS CEMENT, NEAT.

Water used in mixing, 25 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Mos.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.03	3.98	4.08	16.24	.....	57,200	3,520	.....
7	.....	3.99	4.10	4.09	16.77	.....	56,700	3,380	.....
7	.....	4.00	4.05	4.09	16.56	.....	56,500	3,410	.....
7	.....	4.02	3.98	4.05	16.12	.....	59,800	3,710	.....
7	.....	3.96	4.05	4.04	16.36	.....	56,100	3,430	3,490
.....	1	3.97	4.03	4.03	16.24	.....	89,800	5,530	.....
.....	1	4.00	4.03	4.09	16.48	.....	88,800	5,360	.....
.....	1	4.00	4.01	4.00	16.04	.....	88,200	5,190	.....
.....	1	3.98	4.05	4.10	16.61	.....	89,100	5,360	.....
.....	1	4.00	4.06	4.00	16.24	.....	88,000	5,420	5,370
.....	3	3.95	4.07	4.01	16.32	83,800	95,500	5,850	.....
.....	3	3.97	4.09	3.99	16.32	.....	95,400	5,850	.....
.....	3	3.98	4.03	3.99	16.08	.....	95,800	5,960	.....
.....	3	3.98	4.03	4.00	16.12	.....	94,000	5,830	5,870

LEHIGH CEMENT, NEAT.

FIRST SERIES.

Water used in mixing, 26.8 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Mos.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.02	4.07	3.95	16.08	.....	69,900	4,347	.....
7	.....	4.02	4.01	4.10	16.44	.....	67,300	4,097	.....
7	.....	4.09	4.01	4.02	16.12	.....	68,000	4,218	.....
7	.....	4.07	4.01	4.04	16.20	.....	72,400	4,469	4,280
.....	1	4.14	4.00	3.99	15.96	87,000	89,900	5,583	.....
.....	1	4.10	4.02	3.99	16.04	93,800	95,500	5,954	.....
.....	1	4.03	3.94	4.03	15.88	87,900	87,900	5,535	.....
.....	1	4.04	4.01	4.00	16.04	84,100	84,100	5,243	5,590
.....	3	4.03	4.05	4.00	16.20	97,600	103,500	6,389	.....
.....	3	4.05	4.08	4.00	16.32	97,600	97,600	5,980	.....
.....	3	4.00	4.05	4.00	16.20	105,000	106,300	6,562	6,310

LEHIGH CEMENT, NEAT.

SECOND SERIES.

Water used in mixing, 18 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.04	3.98	4.02	16.00	.....	91,500	5,720	.....
7	.....	4.16	3.97	4.03	16.00	.....	79,900	4,990	.....
7	.....	3.99	4.07	4.03	16.40	.....	99,500	6,070	.....
7	.....	4.05	3.98	4.06	16.16	.....	102,100	6,320	5,780
.....	1	3.99	4.10	3.96	16.24	.....	99,500	6,130	.....
.....	1	3.99	4.10	3.98	16.32	70,000	95,100	5,830	.....
.....	1	3.99	4.06	4.00	16.24	.....	104,600	6,440	.....
.....	1	4.00	4.05	4.00	16.20	81,700	89,700	5,540	5,990
.....	3	4.00	4.06	4.00	16.24	117,000	118,100	7,270	.....
.....	3	3.99	4.10	4.05	16.60	102,000	113,000	6,810	.....
.....	3	3.96	4.10	3.99	16.36	103,000	110,000	6,720	.....
.....	3	3.96	4.01	4.05	16.24	113,500	118,500	6,990	.....
.....	3	4.00	4.06	4.02	16.32	115,000	116,200	7,120	6,980

STAR PORTLAND CEMENT, NEAT.

WITH PLASTER.

Water used in mixing, 22½ per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.98	4.04	4.03	16.48	.....	100,100	6,074	.....
7	.....	3.99	4.04	4.00	16.16	.....	101,200	6,262	.....
7	.....	4.01	3.97	4.00	15.88	79,000	87,000	5,479	.....
7	.....	4.00	3.98	3.91	15.56	.....	93,700	6,022	5,960
.....	1	4.00	4.02	3.80	15.28	102,200	102,200	6,688	.....
.....	1	4.00	4.05	3.90	15.80	100,200	113,100	7,158	.....
.....	1	4.00	3.99	4.01	16.00	120,600	120,600	7,538	.....
.....	1	4.01	4.00	3.86	15.44	101,500	107,300	6,949	7,080
.....	3	3.98	4.01	4.03	16.16	140,800	140,800	8,713	.....
.....	3	4.07	3.99	3.99	15.92	119,900	119,900	7,531	.....
.....	3	4.06	3.98	4.02	16.00	131,400	131,400	8,213	.....
.....	3	4.07	3.99	4.02	16.04	132,000	132,000	8,229	8,170

STAR PORTLAND CEMENT, NEAT.

WITH PLASTER.

Water used in mixing, 25 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.03	3.98	4.07	16.20	.....	101,300	6,254	.....
7	.....	3.99	4.06	4.08	16.56	.....	105,200	6,367	.....
7	.....	4.00	4.00	4.08	16.32	.....	102,300	6,268	.....
7	.....	4.02	4.00	4.10	16.40	.....	105,000	6,403	6,320
.....	1	4.02	3.98	4.00	15.92	.....	106,800	6,709	.....
.....	1	4.02	3.98	4.09	16.28	.....	110,100	6,763	.....
.....	1	4.04	3.97	4.07	16.16	.....	106,500	6,590	.....
.....	1	4.01	4.00	4.04	16.16	.....	111,900	6,925	6,750
.....	3	4.02	3.96	4.07	16.12	.....	131,500	8,157	.....
.....	3	3.99	4.06	4.03	16.36	125,900	134,100	8,197	.....
.....	3	4.02	3.97	4.06	16.12	.....	132,200	8,201	.....
.....	3	4.04	3.96	4.06	16.08	125,100	131,000	8,147	8,180

Star Portland Cement, Neat.

WITH PLASTER.

Water used in mixing, 30 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.95	4.05	4.19	16.97	.....	106,800	6,293	.....
8	.....	3.96	4.01	4.18	16.76	.....	105,700	6,307	.....
8	.....	4.09	3.98	4.20	16.72	96,000	99,100	5,927	.....
8	.....	3.97	4.06	4.18	16.97	103,400	116,200	6,848	6,340
.....	1	4.04	3.97	4.08	16.20	.....	109,500	6,759	.....
.....	1	4.02	4.00	4.18	16.72	62,000	116,000	6,938	.....
.....	1	4.00	4.00	4.11	16.44	76,000	112,000	6,813	.....
.....	1	3.97	4.01	4.08	16.36	104,000	112,900	6,901	6,850
.....	3	3.96	4.01	4.12	16.52	102,000	126,200	7,639	.....
.....	3	4.00	3.96	4.10	16.24	108,000	126,000	7,759	.....
.....	3	4.00	4.02	4.09	16.44	103,000	133,200	8,102	.....
.....	3	4.01	3.99	4.09	16.32	76,000	120,500	7,384	7,720

Star Portland Cement. Neat.

WITHOUT PLASTER.

Water used in mixing, 22½ per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.05	4.00	4.10	16.40	.....	69,200	4,220	.....
7	.....	3.97	4.03	4.15	16.72	.....	75,800	4,533	.....
7	.....	3.96	4.00	4.15	16.60	.....	80,100	4,825	.....
7	.....	3.95	4.06	4.16	16.89	.....	82,700	4,896	4,620
.....	1	3.97	4.03	4.10	16.52	82,500	82,500	4,994	.....
.....	1	3.97	4.02	4.06	16.40	77,200	77,200	4,707	.....
.....	1	4.01	4.00	4.10	16.40	77,400	88,400	5,390	.....
.....	1	3.98	4.01	4.07	16.32	92,000	92,000	5,637	5,180
.....	3	4.04	3.96	4.10	16.24	93,300	93,300	5,745	.....
.....	3	4.02	3.97	4.10	16.28	97,600	97,600	5,995	.....
.....	3	4.02	3.97	4.13	16.40	92,200	92,200	5,622	.....
.....	3	4.00	3.96	4.10	16.24	103,100	103,100	6,349	5,980

STAR PORTLAND CEMENT. NEAT.

WITHOUT PLASTER.

Water used in mixing, 25 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.99	4.07	3.99	16.24	.....	96,800	5,930	.....
7	.....	4.00	4.05	4.00	16.20	.....	86,800	5,358	.....
7	.....	3.99	4.02	4.02	16.16	.....	88,700	5,489	.....
7	.....	4.01	4.09	4.08	16.48	.....	89,800	5,449	5,560
.....	1	4.00	4.04	4.00	16.16	.....	99,100	6,132	.....
.....	1	4.07	3.99	4.06	16.20	.....	86,800	5,358	.....
.....	1	4.01	4.00	4.02	16.08	.....	100,100	6,225	.....
.....	1	4.08	4.00	4.05	16.20	.....	100,400	6,198	5,980
.....	3	4.05	4.02	4.01	16.12	108,000	121,600	7,543	.....
.....	3	4.09	4.00	4.03	16.12	122,000	124,500	7,723	.....
.....	3	4.08	4.08	3.99	16.08	104,000	125,900	7,830	.....
.....	3	4.00	4.05	4.01	16.24	89,000	126,800	7,808	7,780

STAR PORTLAND CEMENT, NEAT.

WITHOUT PLASTER.

Water used in mixing, 30 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.95	4.02	4.13	16.60	.....	78,100	4,705	.....
8	.....	4.05	3.99	4.20	16.76	64,100	83,600	4,988	.....
8	.....	4.05	3.99	4.19	16.72	.....	80,600	4,821	.....
8	.....	4.06	3.97	4.14	16.44	.....	92,050	5,599	5,090
.....	1	3.99	4.03	4.20	16.93	74,000	89,900	5,310	.....
.....	1	3.99	4.00	4.15	16.60	91,600	96,200	5,795	.....
.....	1	3.94	4.02	4.17	16.76	85,800	93,400	5,573	.....
.....	1	3.96	4.05	4.14	16.77	97,000	97,500	5,814	5,620
.....	3	3.98	4.00	4.07	16.28	99,800	114,000	7,002	.....
.....	3	3.96	4.01	4.12	16.52	99,000	118,206	7,155	.....
.....	3	3.98	4.01	4.21	16.88	109,000	109,000	6,457	.....
.....	3	3.97	4.08	4.11	16.56	107,400	110,000	6,643	6,810

WHITEHALL CEMENT, NEAT.

Water used in mixing, 25 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.95	3.92	4.04	15.84	.....	88,600	5,593	.....
7	.....	4.04	3.94	3.96	15.60	.....	76,100	4,878	.....
7	.....	4.05	3.96	3.96	15.68	.....	89,900	5,733	.....
7	.....	4.04	3.98	3.95	15.72	88,200	94,700	6,024	.....
7	.....	4.06	3.95	3.96	15.64	.....	92,400	5,908	5,630
.....	1	3.98	4.01	4.00	16.04	.....	108,500	6,764	.....
.....	1	3.98	4.02	3.97	15.96	.....	115,400	7,231	.....
.....	1	4.00	4.02	4.00	16.08	85,000	95,300	5,927	.....
.....	1	4.00	4.07	4.00	16.28	97,000	102,000	6,265	.....
.....	1	3.97	4.02	4.00	16.08	.....	112,900	7,021	6,640
.....	3	3.96	4.04	3.97	16.04	.....	120,500	7,512	.....
.....	3	3.98	4.04	4.00	16.16	.....	130,300	8,063	.....
.....	3	3.96	4.03	3.95	15.92	.....	122,900	7,720	.....
.....	3	3.96	4.05	3.98	16.12	.....	116,300	7,215	7,630

ALSEN CEMENT, NEAT.

Water used in mixing, 29.2 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.06	4.09	3.96	16.20	.....	54,800	3,380	.....
7	.....	4.06	4.05	3.97	16.08	.....	57,700	3,590	.....
7	.....	3.99	4.10	4.02	16.48	.....	57,300	3,480	.....
7	.....	4.04	4.12	3.99	16.44	.....	57,500	3,500	.....
7	.....	4.01	4.03	3.98	16.04	.....	57,400	3,580	3,510
.....	1	3.99	4.06	4.07	16.52	.....	81,900	4,960	.....
.....	1	3.98	4.08	4.09	16.69	.....	81,500	4,880	.....
.....	1	3.99	4.04	4.08	16.48	.....	79,600	4,830	.....
.....	1	4.00	4.03	4.09	16.48	.....	82,300	4,990	.....
.....	1	3.99	4.07	4.02	16.36	.....	82,100	5,020	4,940
.....	3	3.97	4.06	4.05	16.44	91,000	93,500	5,690	.....
.....	3	3.96	4.06	4.07	16.52	.....	85,200	5,160	.....
.....	3	3.97	4.06	4.12	16.73	76,000	93,900	5,610	.....
.....	3	3.99	4.03	4.08	16.44	.....	93,700	5,700	.....
.....	3	3.98	4.04	4.07	16.44	.....	88,300	5,370	5,510

JOSSON CEMENT, NEAT.

Water used in mixing, 26.7 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.00	4.10	3.91	16.03	39,900	45,800	2,860	.....
7	.....	4.04	4.00	4.00	16.00	.....	43,300	2,710	.....
7	.....	3.95	4.02	3.96	15.92	.....	43,200	2,710	.....
7	.....	3.99	4.04	4.00	16.16	.....	44,300	2,740	.....
7	.....	4.07	4.00	4.01	16.04	.....	43,500	2,710	2,750
.....	1	4.02	4.00	4.00	16.00	.....	67,800	4,240	.....
.....	1	4.05	3.99	4.00	15.96	.....	64,400	4,040	.....
.....	1	4.09	3.99	3.96	15.80	.....	61,500	3,890	.....
.....	1	4.00	4.01	3.98	15.96	.....	63,500	3,980	.....
.....	1	4.06	4.00	4.00	16.00	.....	64,000	4,000	4,030
.....	3	4.06	4.00	4.02	16.08	.....	73,700	4,580	.....
.....	3	3.98	4.00	3.98	15.92	.....	75,100	4,720	.....
.....	3	4.06	4.01	3.92	15.72	.....	76,600	4,870	.....
.....	3	4.08	4.00	3.98	15.92	.....	74,100	4,650	.....
.....	3	4.08	4.00	3.99	15.96	.....	71,800	4,500	4,660

CATHEDRAL CEMENT, NEAT.

FIRST SERIES.

Water used in mixing, 26.7 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.00	4.03	4.01	16.16	.....	36,500	2,260	.....
7	.....	4.00	3.96	4.02	15.92	.....	34,200	2,150	.....
7	.....	3.95	4.04	4.00	16.16	.....	33,640	2,080	.....
7	.....	4.02	4.07	4.00	16.28	.....	35,050	2,150	.....
7	.....	3.95	4.01	4.02	16.24	.....	30,900	1,900	2,110
.....	1	3.97	4.04	3.93	15.88	.....	46,100	2,900	.....
.....	1	3.97	4.04	4.00	16.16	.....	48,500	3,000	.....
.....	1	3.96	4.05	4.03	16.32	.....	50,100	3,070	.....
.....	1	3.96	4.01	4.08	16.36	.....	48,700	2,980	.....
.....	1	3.98	4.04	3.99	16.12	.....	47,000	2,920	2,970
.....	3	3.96	4.06	3.99	16.20	.....	56,700	3,500	.....
.....	3	3.93	4.05	4.00	16.20	.....	53,900	3,330	.....
.....	3	3.97	4.06	4.03	16.36	.....	60,800	3,720	.....
.....	3	3.96	4.00	4.00	16.00	.....	49,900	3,120	.....
.....	3	3.99	4.03	3.99	16.08	.....	55,900	3,480	3,430

CATHEDRAL CEMENT, NEAT.

SECOND SERIES.

Water used in mixing, 18 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
8	.....	4.09	3.99	4.05	16.16	.....	59,900	3,710	.....
8	.....	3.99	4.07	4.10	16.69	.....	66,300	3,970	.....
8	.....	4.10	3.99	3.73	14.88	.....	61,200	4,110	.....
8	.....	4.00	4.07	4.06	16.52	.....	56,500	3,420	.....
8	.....	3.99	4.07	4.07	16.56	.....	67,500	4,080	3,860
.....	1	4.08	3.98	4.00	15.92	59,800	63,800	4,010	.....
.....	1	4.04	3.96	4.02	16.00	58,600	63,400	3,960	.....
.....	1	4.08	3.99	4.03	16.08	67,000	69,300	4,310	.....
.....	1	4.09	4.00	4.06	16.24	.....	68,000	4,190	.....
.....	1	4.06	3.99	3.79	15.12	.....	51,000	3,370	3,970
.....	3	4.05	3.99	4.01	16.00	75,500	75,700	4,730	.....
.....	3	4.09	3.96	4.01	15.96	39,000	78,500	4,610	.....
.....	3	4.14	3.99	3.98	15.88	52,000	70,100	4,410	.....
.....	3	4.18	3.98	4.02	16.00	64,000	67,200	4,200	4,490

SILICA CEMENT, NEAT.

FIRST SERIES.

Water used in mixing, 28½ per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.05	4.00	4.06	16.24	.....	19,950	1,228	.....
7	.....	4.00	4.09	4.08	16.68	.....	22,600	1,355	.....
7	.....	4.08	3.98	4.13	16.44	.....	20,900	1,271	.....
7	.....	3.96	4.08	4.07	16.40	.....	19,980	1,218	.....
7	.....	3.96	4.06	4.10	16.64	.....	23,500	1,412	1,300
.....	1	3.96	4.15	4.04	16.77	.....	27,100	1,616	.....
.....	1	3.97	4.02	4.18	16.80	.....	30,600	1,821	.....
.....	1	3.96	4.04	4.07	16.44	.....	33,500	2,038	.....
.....	1	3.98	4.04	4.06	16.40	.....	27,900	1,701	.....
.....	1	4.00	4.13	4.00	16.69	.....	29,500	1,768	1,790
.....	3	3.97	4.01	4.10	16.44	.....	32,800	1,995	.....
.....	3	3.99	4.05	4.05	16.40	.....	34,100	2,079	.....
.....	3	3.96	4.06	4.09	16.69	.....	34,500	2,067	.....
.....	3	3.98	4.01	4.18	16.76	.....	39,200	2,339	.....
.....	3	3.96	4.05	4.10	16.61	.....	34,500	2,077	2,110
.....	12	3.96	4.03	4.19	16.89	33,600	33,600	1,990	.....
.....	12	3.98	4.07	4.10	16.69	39,900	39,900	2,390	2,190

Silica Cement, Neat.

SECOND SERIES.

Water used in mixing, 18 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
8	.....	4.00	3.92	4.13	16.19	.....	47,100	2,910	.....
8	.....	4.06	3.99	4.00	15.96	.....	53,100	3,330	.....
8	.....	4.08	4.00	3.95	15.80	.....	53,400	3,380	.....
8	.....	4.02	4.06	3.86	15.67	.....	43,600	2,780	.....
8	.....	3.99	3.98	4.08	16.24	.....	46,500	2,860	3,050
.....	1	4.00	4.03	3.98	16.04	.....	54,900	3,420	.....
.....	1	4.00	4.02	4.08	16.40	52,300	60,600	3,700	.....
.....	1	4.08	4.01	4.00	16.04	.....	65,800	4,100	.....
.....	1	4.05	4.01	3.98	15.96	.....	39,500	2,480	.....
.....	1	4.07	4.00	4.06	16.24	.....	59,400	3,660	3,470
.....	3	4.06	3.98	4.05	16.12	66,000	76,100	4,720	.....
.....	3	4.00	4.09	4.03	16.48	68,200	70,500	4,280	.....
.....	3	4.08	4.00	4.02	16.08	72,500	73,600	4,580	.....
.....	3	3.98	4.05	4.06	16.44	70,600	70,600	4,290	4,470

Austin Cement, Neat.

Water used in mixing, 35.4 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.98	4.02	4.06	16.32	.....	5,950	360	.....
7	.....	4.05	3.98	4.10	16.32	.....	5,420	330	.....
7	.....	3.98	4.04	4.08	16.48	.....	6,100	370	.....
7	.....	4.03	4.00	4.02	16.08	.....	5,430	340	.....
7	.....	4.03	3.95	4.05	16.00	.....	6,060	380	356
.....	1	3.97	4.05	4.14	16.77	.....	15,900	950	.....
.....	1	3.99	4.00	4.08	16.32	.....	19,400	1,190	.....
.....	1	3.98	4.07	4.06	16.52	.....	18,700	1,130	.....
.....	1	3.96	4.06	4.10	16.65	.....	18,100	1,090	.....
.....	1	3.97	4.07	4.08	16.61	.....	18,500	1,110	1,090
.....	3	3.98	4.01	4.12	16.52	11,100	23,100	1,400	.....
.....	3	3.95	4.07	4.01	16.32	10,000	24,200	1,480	.....
.....	3	3.97	4.01	4.10	16.44	17,500	24,900	1,510	.....
.....	3	3.97	4.08	4.08	16.65	26,200	27,300	1,640	.....
.....	3	3.95	4.06	4.10	16.65	25,400	26,900	1,620	1,580

Bonneville Improved Cement, Neat.

Water used in mixing, 38.7 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.02	3.97	4.10	16.28	.....	9,500	583	.....
7	.....	4.11	3.98	4.08	16.24	.....	9,500	585	.....
7	.....	4.03	3.98	4.10	16.32	.....	10,100	619	.....
7	.....	3.98	4.02	4.09	16.44	.....	10,900	663	.....
7	.....	4.02	3.97	4.05	16.08	.....	10,500	653	620
.....	1	3.99	4.08	4.06	16.56	.....	19,400	1,171	.....
.....	1	3.97	4.07	4.07	16.56	.....	17,900	1,081	.....
.....	1	4.00	4.02	4.10	16.48	.....	18,500	1,123	.....
.....	1	4.00	4.01	4.08	16.16	.....	18,600	1,151	.....
.....	1	3.98	4.02	4.12	16.56	.....	18,800	1,135	1,130
.....	3	4.00	4.04	4.08	16.48	21,000	26,300	1,596	.....
.....	3	3.96	4.06	4.03	16.36	21,500	24,200	1,479	.....
.....	3	3.96	4.05	4.08	16.52	20,000	26,500	1,604	.....
.....	3	3.97	4.01	4.06	16.28	.....	23,900	1,468	.....
.....	3	3.98	4.05	4.11	16.65	24,100	27,200	1,634	1,560

Hoffman Cement, Neat.

Water used in mixing, 36.2 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.05	3.96	4.05	16.04	.....	7,100	440	.....
7	.....	3.99	4.01	3.98	15.96	.....	7,980	500	.....
7	.....	4.00	4.09	4.10	16.77	.....	7,600	450	.....
7	.....	4.00	4.08	4.08	16.65	.....	7,900	470	.....
7	.....	3.99	4.09	4.08	16.69	.....	7,650	460	464
.....	1	4.09	4.00	4.05	16.20	.....	13,600	840	.....
.....	1	4.06	4.01	4.05	16.24	.....	12,500	770	.....
.....	1	4.02	4.09	4.09	16.73	.....	13,100	780	.....
.....	1	4.00	4.11	4.07	16.73	.....	12,900	770	.....
.....	1	4.06	3.99	4.06	16.20	.....	12,800	790	790
.....	3	4.00	3.96	4.05	16.04	14,900	20,500	1,280	.....
.....	3	4.03	3.99	4.06	16.20	.....	20,500	1,270	.....
.....	3	4.04	4.01	4.06	16.28	.....	19,900	1,220	.....
.....	3	4.08	3.98	4.07	16.20	.....	19,100	1,180	.....
.....	3	4.03	3.95	4.01	15.84	.....	18,800	1,190	1,230

MANKATO CEMENT, NEAT.

Water used in mixing, 41.2 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.01	3.96	4.02	15.92	.....	9,800	620	.....
7	.....	4.02	3.99	4.00	15.96	.....	8,520	530	.....
7	.....	3.96	4.01	4.00	16.04	.....	9,190	570	.....
7	.....	4.05	3.99	4.00	15.96	.....	9,020	570	.....
7	.....	4.04	3.99	4.03	16.08	.....	8,600	540	566
.....	1	4.04	3.98	4.05	16.12	.....	16,500	1,020	.....
.....	1	3.97	4.02	4.01	16.12	.....	16,700	1,040	.....
.....	1	3.98	4.06	4.01	16.28	.....	16,000	980	.....
.....	1	3.97	4.08	4.05	16.52	.....	16,300	990	.....
.....	1	3.99	3.99	4.02	16.04	.....	17,300	1,080	1,020
.....	3	3.96	4.02	4.03	16.20	.....	23,400	1,440	.....
.....	3	3.97	4.06	4.09	16.61	.....	23,600	1,420	.....
.....	3	3.98	4.02	4.10	16.48	.....	23,800	1,440	.....
.....	3	3.99	4.06	4.09	16.61	20,000	23,200	1,400	.....
.....	3	3.98	4.02	4.05	16.28	.....	22,600	1,390	1,420

NEWARK AND ROSENDALE CEMENT, NEAT.

Water used in mixing, 38.7 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.02	3.99	4.05	16.16	.....	7,260	449	.....
7	.....	4.00	4.11	4.04	16.60	.....	6,300	380	.....
7	.....	4.05	3.98	4.13	16.44	.....	6,900	420	.....
8	.....	4.03	4.00	4.02	16.08	.....	6,540	407	.....
7	.....	3.98	4.02	4.07	16.36	.....	6,200	379	407
.....	1	4.04	4.08	3.97	16.20	.....	18,800	1,160	.....
.....	1	3.98	4.12	4.04	16.64	.....	16,500	992	.....
.....	1	4.05	4.15	3.97	16.48	.....	17,600	1,068	.....
.....	1	4.06	4.02	3.98	16.00	.....	18,100	1,131	1,090
.....	3	4.08	3.99	4.10	16.36	.....	22,100	1,351	.....
.....	3	4.08	3.98	4.12	16.40	22,200	23,400	1,427	.....
.....	3	4.04	4.00	4.09	16.36	22,700	23,800	1,455	.....
.....	3	4.05	3.99	4.13	16.48	20,400	25,100	1,523	.....
.....	3	3.99	4.05	4.10	16.60	.....	23,800	1,434	1,440
.....	12	3.98	3.97	4.12	16.36	21,000	24,950	1,530	.....
.....	12	3.97	4.04	4.08	16.48	.....	29,300	1,780	.....
.....	12	3.98	4.00	4.02	16.08	22,800	23,300	1,450	1,590

NORTON CEMENT, NEAT.

Water used in mixing, 39.6 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.02	3.98	4.04	16.08	.....	7,620	470	.....
7	.....	3.99	4.02	4.07	16.36	.....	8,150	500	.....
7	.....	4.03	3.98	4.08	16.24	.....	6,920	430	.....
7	.....	3.96	4.02	4.06	16.32	.....	7,900	480	.....
7	.....	3.98	4.04	4.09	16.52	.....	7,920	480	472
.....	1	3.97	4.04	4.05	16.36	.....	15,900	970	.....
.....	1	3.98	4.00	4.12	16.48	.....	14,800	900	.....
.....	1	3.97	4.03	4.05	16.32	.....	13,700	840	.....
.....	1	3.97	4.05	4.01	16.24	.....	13,500	830	.....
.....	1	3.99	4.06	4.02	16.32	.....	14,100	860	880
.....	3	3.98	4.05	4.02	16.28	24,800	26,100	1,600	.....
.....	3	3.99	4.02	4.01	16.12	.....	27,100	1,680	.....
.....	3	3.98	4.04	4.03	16.28	.....	27,000	1,660	.....
.....	3	3.98	4.04	4.06	16.40	.....	24,200	1,480	.....
.....	3	3.98	4.11	4.05	16.65	14,600	23,700	1,420	1,570

OBELISK CEMENT, NEAT.

Water used in mixing, 35.8 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	4.05	4.00	3.99	15.96	.....	11,800	739	.....
7	.....	4.01	4.00	4.02	16.08	.....	12,600	784	.....
7	.....	4.05	4.00	4.02	16.08	.....	12,400	771	.....
7	.....	4.08	4.00	3.99	15.96	.....	12,000	752	.....
7	.....	4.00	4.03	4.00	16.12	.....	11,400	707	750
.....	1	4.08	3.97	4.02	15.96	11,000	18,100	1,134	.....
.....	1	4.04	4.01	4.01	16.08	.....	23,100	1,437	.....
.....	1	3.99	4.05	4.02	16.28	.....	22,800	1,400	.....
.....	1	4.00	4.00	4.06	16.24	.....	23,600	1,453	.....
.....	1	3.99	4.06	4.02	16.32	20,400	22,300	1,366	1,380
.....	3	3.96	4.05	4.05	16.40	35,500	36,500	2,226	.....
.....	3	3.99	4.04	4.04	16.32	.....	35,700	2,188	.....
.....	3	4.00	4.02	4.10	16.48	.....	35,500	2,154	.....
.....	3	4.06	4.00	4.03	16.12	31,200	34,600	2,146	.....
.....	3	4.05	3.99	4.00	15.96	.....	37,700	2,362	2,220

Potomac Cement, Neat.

Water used in mixing, 39.2 per cent.
Set in air.

Age.		Dimensions.			Sectional area.	First crack.	Compressive strength.		
		Height.	Compressed surface.				Total.	Per square inch.	Mean.
Days.	*Months.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*
7	.....	3.97	4.00	4.10	16.40	.....	6,680	407	.....
7	.....	3.98	4.01	4.04	16.20	.....	6,960	430	.....
7	.....	3.98	4.03	4.02	16.20	.....	7,100	438	.....
7	.....	4.04	4.01	4.00	16.04	.....	6,850	427	.....
7	.....	3.99	4.09	4.03	16.48	.....	6,820	414	423
.....	1	3.96	4.03	4.02	16.20	.....	14,100	870	.....
.....	1	3.98	3.98	4.06	16.16	.....	13,800	854	.....
.....	1	3.96	4.00	4.06	16.24	.....	12,200	751	.....
.....	1	3.98	4.04	4.03	16.28	.....	14,100	866	.....
.....	1	3.97	4.03	4.04	16.28	.....	14,100	860	840
.....	3	4.03	3.97	4.01	15.92	16,700	18,700	1,175	.....
.....	3	4.02	3.99	4.04	16.12	13,400	16,200	1,005	.....
.....	3	4.05	3.99	4.02	16.04	7,000	16,700	1,041	.....
.....	3	4.05	3.99	4.00	15.96	.....	19,000	1,190	.....
.....	3	3.97	4.06	4.00	16.24	18,200	18,700	1,151	1,110
.....	12	3.99	4.04	4.02	16.24	.....	16,300	1,000	.....
.....	12	3.98	4.04	4.05	16.36	9,200	19,500	1,190	.....
.....	12	3.98	4.02	4.01	16.12	10,600	19,200	1,190	.....
.....	12	3.97	4.00	4.03	16.12	9,500	16,500	1,020	1,100

Retarded Set Series.

ADDITIONAL TESTS, CUBES SET IN AIR.

Marks, *J 17.
Composition: Star cement, with plaster, neat.
Original water used in gauging, 32.9 per cent of cement.
Age, 9 months.
Retarded 102 hours.
For earlier tests see Report, 1901, page 509.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
102 ☆J 17 (4)	4.00	3.96	3.97	15.72	7,040	8,010	510
102 ☆J 17 (5)	4.03	3.95	3.99	15.76	7,330	7,330	465
102 ☆J 17 (6)	4.01	3.98	3.97	15.60	8,300	8,750	561

The three following cubes were immersed in water 24 hours.

Marks.	Weight before immersion.	Weight after immersion.
	Lbs. ozs.	*Lbs. ozs.*
102 ☆J 17 (7)	3 0	3 14½
102 ☆J 17 (8)	3 0	3 14½
102 ☆J 17 (9)	3 ½	3 14

The cubes were taken from the bath and immediately tested.

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
102 ☆J 17 (7)	4.01	3.96	3.98	15.76	6,240	6,240	396
102 ☆J 17 (8)	4.03	3.96	4.02	15.92	7,100	7,100	446
102 ☆J 17 (9)	4.02	3.94	4.01	15.80	5,200	5,200	329

The next three cubes were immersed in water 24 hours, then allowed to dry in the open air 12 days, at the expiration of which time they were tested.

Marks.	Weight before immersion.	Weight after immersion.	Weight after drying in open air 12 days.
	Lbs. ozs.	*Lbs. ozs.*	*Lbs. ozs.*
102 ☆J 17 (10)	2 15½	3 14	3 2½
102 ☆J 17 (11)	3 1½	3 14½	3 4
102 ☆J 17 (12)	3 ½	3 14½	3 4½

Marks.	Dimensions.			Sectional area.	First crack.	Compressive strength.	
	Height.	Compressed surface.				Total.	Per square inch.
	Inches.	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*
102 ☆J 17 (10)	4.02	3.94	4.00	15.76	6,980	6,980	443
102 ☆J 17 (11)	4.01	3.95	4.10	16.20	6,600	7,320	452
102 ☆J 17 (12)	4.02	3.94	4.00	15.76	7,840	7,840	497

Cements Which Set in Air at Different Temperatures.

DETAILS OF COMPRESSION TESTS OF SPECIMENS WHICH WERE EXPOSED TO 0° F. TEMPERATURE WHILE SETTING, AND SUBSEQUENTLY AT 70° F. ADDITIONAL TESTS.

[See Report 1901, p. 531, for earlier tests of this series.]

Marks.	Brand of cement.	Composition.			Time of setting in air at temperature of—			Dimensions.			Sectional area.	Compressive strength.			Remarks.
		Cement.	Sand.	Water.	Zero F.		70° F.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
				P. ct.	Year.	Mos. Days.	Days.	Inches.	Inches.	Inches.	Sq. in.	Pounds.	Pounds.	Pounds.	
☆1 × 1 F 15	Star	1	1	36.1		9 7	3	2.01	2.03	2.08	4.22	3,200	758		
								2.00	2.01	2.09	4.20	3,280	781	770	
		1	1	36.1	1		1	2.01	2.07	2.01	4.16	3,650	877		
								2.00	2.11	2.00	4.22	4,010	950		
								2.00	2.10	2.00	4.20	3,580	852		
								2.02	2.13	2.02	4.30	3,220	749		
								2.00	2.09	1.99	4.16	3,800	913		
								2.00	2.09	2.00	4.18	3,810	911		
								2.06	2.15	2.02	4.34	3,100	714		
								2.02	2.06	2.00	4.12	3,910	949	864	
☆ F 8	Star	Neat.		23.4		9 14	3	2.01	2.02	2.12	4.28	12,580	2,940		
								2.01	2.05	2.13	4.37	12,500	2,860	2,900	
		Neat.		23.4	1		1	2.07	2.19	2.03	4.45	11,910	2,676		
								2.04	2.14	2.00	4.28	12,000	2,804		
								2.02	2.20	2.02	4.44	12,750	2,871		
								2.00	2.12	2.05	4.34	12,780	2,945		
								2.00	2.12	2.02	4.28	9,950	2,325	2,724	
S. K. J 28	Storm King	Neat.		24.4		9 24	3	2.03	2.00	2.09	4.18	5,400	1,290		
								2.01	2.02	2.12	4.28	5,590	1,310	1,300	
		Neat.		24.4	1		1	2.02	2.12	2.01	4.26	6,400	1,500		
								2.01	2.12	2.03	4.30	5,450	1,270		
								2.00	2.13	2.01	4.28	5,090	1,190		
								2.04	2.06	1.99	4.10	6,290	1,530		
								2.02	2.04	1.94	3.96	5,710	1,440		
								2.01	2.08	2.02	4.20	5,650	1,350		
								2.08	2.08	2.02	4.20	5,000	1,190		
								2.03	2.05	1.96	4.02	5,570	1,390		
								2.03	2.03	1.92	3.90	5,730	1,470	1,370	

DETAILS OF COMPRESSION TESTS OF SPECIMENS WHICH SET IN AIR AT 0° F., PRECEDED BY DIFFERENT INTERVALS AT 70° F., ETC.—Continued.

Marks.	Brand of cement.	Composition.			Time of setting in air at temperatures of—			Dimensions.			Sectional area.	Compressive strength.			Remarks.
		Cement.	Sand.	Water.	70° F.	0° F.	70° F.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
				Per ct.	*Days.*	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
N. & R. F 26	Newark and Rosendale.	Neat.	.....	38.0	1	.....	.....	2.01	2.06	2.06	4.24	890	210	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.03	2.00	4.06	890	219	.....	
		.....	.....	.....	.....	.....	.....	2.03	2.01	2.05	4.12	780	189	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.06	2.02	4.16	880	212	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.06	2.04	4.20	730	174	201	
		Neat.	.....	38.0	9	.....	.....	2.01	2.06	2.07	4.26	2,430	570	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.07	2.07	4.28	2,560	598	.....	
		.....	.....	.....	.....	.....	.....	2.05	2.06	2.01	4.14	2,500	604	.....	
		.....	.....	.....	.....	.....	.....	2.05	2.02	2.03	4.10	2,750	671	.....	
		.....	.....	.....	.....	.....	.....	1.96	2.08	1.99	4.14	2,440	589	606	
		Neat.	.....	38.0	1	7	1	2.08	2.04	2.03	4.14	1,380	333	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.10	2.03	4.26	1,400	329	.....	
		.....	.....	.....	.....	.....	.....	2.03	2.10	2.00	4.20	1,450	345	.....	
		.....	.....	.....	.....	.....	.....	2.04	2.06	2.00	4.13	1,400	339	.....	
		.....	.....	.....	.....	.....	.....	2.01	2.06	2.01	4.14	1,620	391	347	
		Neat.	.....	38.0	31	.....	.....	2.00	2.07	2.02	4.18	4,480	1,070	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.04	2.00	4.06	3,810	934	.....	
		.....	.....	.....	.....	.....	.....	1.98	2.07	2.00	4.14	4,400	1,060	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.06	2.02	4.16	4,330	1,040	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.10	2.08	4.26	3,900	915	1,000	
		Neat.	.....	38.0	1	29	1	1.99	2.05	2.02	4.14	2,010	486	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.06	2.00	4.12	1,980	481	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.04	2.05	4.18	2,000	478	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.07	2.00	4.14	2,100	507	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.08	2.08	4.22	1,900	450	480	
		Neat.	.....	38.0	97	.....	.....	1.99	2.08	1.98	4.12	5,510	1,560	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.08	2.00	4.16	5,320	1,280	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.05	2.00	4.10	4,990	1,220	.....	
		.....	.....	.....	.....	.....	.....	2.00	2.05	2.01	4.12	4,710	1,140	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.08	2.01	4.18	4,300	1,030	1,250	

		Neat.	.....	38.0	1	95	1	2.03	2.07	2.01	4.16	2,400	577	.....
		.....	.....	.....	.....	.....	.....	2.00	2.03	2.01	4.08	2,380	583	.....
		.....	.....	.....	.....	.....	.....	2.06	2.08	1.99	4.14	1,900	459	.....
		.....	.....	.....	.....	.....	.....	2.01	2.08	2.06	4.28	2,190	512	.....
		.....	.....	.....	.....	.....	.....	2.01	2.03	2.05	4.16	2,300	553	537
		Neat.	.....	38.0	184	.....	.....	2.01	2.01	2.08	4.18	6,100	1,460	.....
		.....	.....	.....	.....	.....	.....	2.08	1.96	2.04	4.00	6,700	1,680	.....
		.....	.....	.....	.....	.....	.....	2.06	2.00	2.05	4.10	4,500	1,100	.....
		.....	.....	.....	.....	.....	.....	2.00	2.06	2.01	4.14	5,250	1,270	.....
		.....	.....	.....	.....	.....	.....	2.00	2.01	2.06	4.14	6,500	1,570	1,420
		Neat.	.....	38.0	1	182	1	2.00	2.00	2.08	4.16	2,100	505	.....
		.....	.....	.....	.....	.....	.....	1.94	2.06	2.05	4.22	2,080	493	.....
		.....	.....	.....	.....	.....	.....	1.97	2.00	2.05	4.10	2,300	561	.....
		.....	.....	.....	.....	.....	.....	2.11	1.99	2.03	4.04	2,240	552	.....
		.....	.....	.....	.....	.....	.....	2.01	2.04	2.06	4.20	2,200	524	527
N. & R. M 11...	Newark and Rosendale.	Neat.	.....	38.1	4	.....	.....	2.00	2.06	2.08	4.18	1,400	335	.....
		.....	.....	.....	.....	.....	.....	1.99	2.05	1.97	4.04	1,450	359	.....
		.....	.....	.....	.....	.....	.....	1.99	2.06	2.05	4.22	1,500	355	.....
		.....	.....	.....	.....	.....	.....	2.01	2.05	2.08	4.26	1,410	331	.....
		.....	.....	.....	.....	.....	.....	1.97	2.04	2.00	4.08	1,390	341	344
		Neat.	.....	38.1	14	.....	.....	2.02	2.08	2.00	4.16	2,400	577	.....
		.....	.....	.....	.....	.....	.....	1.99	2.06	1.99	4.10	2,210	539	.....
		.....	.....	.....	.....	.....	.....	2.00	2.09	2.00	4.18	2,420	579	.....
		.....	.....	.....	.....	.....	.....	2.00	2.08	1.98	4.12	2,450	595	.....
		.....	.....	.....	.....	.....	.....	1.94	2.02	2.06	4.16	2,920	702	598
		Neat.	.....	38.1	4	9	1	1.99	3.03	2.04	4.14	2,010	486	.....
		.....	.....	.....	.....	.....	.....	1.99	2.08	1.99	4.14	1,990	481	.....
		.....	.....	.....	.....	.....	.....	1.99	2.05	1.98	4.06	1,900	468	.....
		.....	.....	.....	.....	.....	.....	2.02	2.07	2.02	4.18	1,820	435	.....
		.....	.....	.....	.....	.....	.....	2.02	2.05	1.98	4.06	2,010	495	473
		Neat.	.....	38.1	35	.....	.....	2.02	2.07	2.02	4.18	4,010	959	.....
		.....	.....	.....	.....	.....	.....	2.00	2.06	2.00	4.12	3,750	910	.....
		.....	.....	.....	.....	.....	.....	2.00	2.04	2.00	4.08	4,200	1,030	.....
		.....	.....	.....	.....	.....	.....	2.00	2.05	2.02	4.14	4,550	1,100	.....
		.....	.....	.....	.....	.....	.....	2.00	2.08	1.99	4.14	3,610	872	974
		Neat.	.....	38.1	4	30	1	2.02	2.09	2.02	4.22	2,400	569	.....
		.....	.....	.....	.....	.....	.....	1.97	2.05	2.02	4.14	1,910	461	.....
		.....	.....	.....	.....	.....	.....	1.99	2.07	2.02	4.18	2,080	498	.....
		.....	.....	.....	.....	.....	.....	1.99	2.06	1.98	4.08	2,270	556	.....
		.....	.....	.....	.....	.....	.....	1.99	2.07	2.02	4.18	2,090	500	517

ILS OF COMPRESSION TESTS OF SPECIMENS WHICH SET IN AIR AT 0° F., PRECEDED BY DIFFERENT INTERVALS AT 70° F., ETC.—Continued.

Marks.	Brand of cement.	Composition.			Time of setting in air at temperatures of—			Dimensions.			Sectional area.	Compressive strength.			Remarks.
		Cement.	Sand.	Water.	70° F.	0° F.	70° F.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
				Per ct.	*Days.*	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
N. & R. M. 11..	Newark and Rosendale.	Neat.	.....	38.1	98	.....	.....	2.01	2.04	2.02	4.12	5,300	1,290	.....	
		.....	.....	.....	.....	.....	.....	1.90	2.04	1.90	3.88	5,480	1,410	.....	
		.....	.....	.....	.....	.....	.....	1.98	2.08	1.98	4.12	5,410	1,310	.....	
		.....	.....	.....	.....	.....	.....	1.98	2.04	2.00	4.08	4,580	1,120	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.04	2.03	4.14	4,050	980	1,220	
		Neat.	.....	38.1	4	93	1	2.06	2.08	2.02	4.20	2,510	598	.....	
		.....	.....	.....	.....	.....	.....	2.05	2.04	2.01	4.10	2,830	690	.....	
		.....	.....	.....	.....	.....	.....	1.98	2.07	2.01	4.16	2,390	575	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.04	2.03	4.14	3,000	725	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.05	1.98	4.06	2,650	653	648	
		Neat.	.....	38.1	192	.....	.....	1.98	1.95	2.03	3.96	4,100	1,040	.....	
		.....	.....	.....	.....	.....	.....	2.06	2.00	2.04	4.08	5,900	1,450	.....	
		.....	.....	.....	.....	.....	.....	1.99	1.99	2.05	4.08	7,100	1,740	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.02	2.05	4.14	6,400	1,550	.....	
		.....	.....	.....	.....	.....	.....	2.00	1.98	2.06	4.08	6,400	1,570	1,470	
		Neat.	.....	38.1	4	188	1	2.06	1.99	2.04	4.06	2,450	603	.....	
		.....	.....	.....	.....	.....	.....	2.01	2.07	2.06	4.26	2,800	657	.....	
		.....	.....	.....	.....	.....	.....	2.04	2.02	2.05	4.14	3,200	773	.....	
		.....	.....	.....	.....	.....	.....	2.02	1.95	2.02	3.94	2,400	609	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.00	2.06	4.12	2,700	655	659	
N. & R. M. 1....	Newark and Rosendale.	Neat.	.....	8.81	7	.....	.....	2.04	2.03	2.02	4.10	1,960	478	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.01	2.04	4.10	2,120	517	.....	
		.....	.....	.....	.....	.....	.....	1.92	2.05	2.05	4.20	1,640	390	.....	
		.....	.....	.....	.....	.....	.....	2.06	2.03	2.02	4.10	1,560	380	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.02	2.00	4.04	1,810	448	443	
		Neat.	.....	38.1	15	.....	.....	2.02	2.04	2.01	4.10	2,690	656	.....	
		.....	.....	.....	.....	.....	.....	2.04	2.01	2.02	4.06	2,450	603	.....	
		.....	.....	.....	.....	.....	.....	2.06	2.04	2.04	4.16	2,210	531	.....	
		.....	.....	.....	.....	.....	.....	2.02	2.02	2.03	4.10	2,450	598	.....	
		.....	.....	.....	.....	.....	.....	1.99	2.03	1.98	4.02	2,500	622	602	

	Neat.	.....	38.1	7	7	1	1.98	2.03	2.00	4.06	2,150	530	.....
	.....	.....	.....	.....	.....	.....	2.05	2.02	1.97	3.98	2,020	508	.....
	.....	.....	.....	.....	.....	.....	2.04	2.02	2.02	4.08	2,100	515	.....
	.....	.....	.....	.....	.....	.....	2.04	2.03	2.05	4.16	2,110	507	.....
	.....	.....	.....	.....	.....	.....	2.01	2.01	1.99	4.00	2,060	515	515
	Neat.	.....	38.1	40	.....	.....	2.01	2.02	2.04	4.16	4,590	1,100	.....
	.....	.....	.....	.....	.....	.....	2.07	2.02	2.01	4.06	4,630	1,140	.....
	.....	.....	.....	.....	.....	.....	2.00	2.03	2.02	4.10	4,280	1,040	.....
	.....	.....	.....	.....	.....	.....	1.99	2.04	2.07	4.22	4,300	1,020	.....
	.....	.....	.....	.....	.....	.....	2.06	2.03	2.04	4.14	4,540	1,100	1,080
	Neat.	.....	38.1	7	32	1	2.00	2.02	2.06	4.16	2,990	719	.....
	.....	.....	.....	.....	.....	.....	2.00	2.01	2.05	4.12	2,700	655	.....
	.....	.....	.....	.....	.....	.....	2.00	2.04	1.99	4.06	2,910	717	.....
	.....	.....	.....	.....	.....	.....	2.04	2.01	2.02	4.06	2,520	621	.....
	.....	.....	.....	.....	.....	.....	2.02	2.06	2.04	4.20	2,950	702	683
	Neat.	.....	38.1	100	.....	.....	2.08	2.04	2.03	4.14	6,400	1,550	.....
	.....	.....	.....	.....	.....	.....	2.00	2.01	2.00	4.02	5,200	1,290	.....
	.....	.....	.....	.....	.....	.....	2.01	2.03	2.01	4.08	5,300	1,300	.....
	.....	.....	.....	.....	.....	.....	2.02	2.03	2.00	4.06	5,500	1,350	.....
	.....	.....	.....	.....	.....	.....	1.98	2.04	2.01	4.10	5,000	1,220	1,340
	Neat.	.....	38.1	7	92	1	2.01	2.04	2.05	4.18	3,300	789	.....
	.....	.....	.....	.....	.....	.....	2.01	2.01	2.05	4.12	2,900	704	.....
	.....	.....	.....	.....	.....	.....	2.04	2.03	2.03	4.12	3,500	850	.....
	.....	.....	.....	.....	.....	.....	2.01	2.04	2.06	4.20	3,300	786	.....
	.....	.....	.....	.....	.....	.....	2.04	2.04	2.02	4.12	3,300	801	786
	Neat.	.....	38.1	191	.....	.....	1.95	2.05	2.04	4.18	4,900	1,170	.....
	.....	.....	.....	.....	.....	.....	2.01	2.06	2.02	4.16	5,200	1,250	.....
	.....	.....	.....	.....	.....	.....	2.06	1.92	2.06	3.98	4,600	1,160	.....
	.....	.....	.....	.....	.....	.....	2.06	2.02	2.02	4.08	5,900	1,450	.....
	.....	.....	.....	.....	.....	.....	2.01	2.03	2.02	4.10	6,400	1,560	1,320
	Neat.	.....	38.1	7	183	1	2.04	2.04	2.05	4.18	3,100	742	.....
	.....	.....	.....	.....	.....	.....	2.02	2.00	2.06	4.12	3,700	898	.....
	.....	.....	.....	.....	.....	.....	1.99	2.03	2.02	4.10	4,400	1,070	.....
	.....	.....	.....	.....	.....	.....	2.00	2.02	2.04	4.12	3,300	800	.....
	.....	.....	.....	.....	.....	.....	1.97	2.01	2.00	4.02	4,100	1,020	906

Cements Which Set in Air at Different Temperatures.

RÉSUMÉ OF RESULTS.

Brand of cement.	Date of manufacture.	Composition.			Time of setting in air at temperatures of—			Total age.	Mean compressive strength per square inch.	Remarks.
		Cement.	Sand.	Water.	70° F.	0° F.	70° F.			
	1902.			*Per cent.*	*Days.*	*Days.*	*Days.*	*Days.*	*Pounds.*	
Alpha	Feb. 20	Neat.		25.0	1			1	582	
					9			9	4,990	
					33			33	6,320	
					93			93	5,430	
					181			181	5,910	
Do	do	Neat.		25.0	1	7	1	9	2,400	
					1	31	1	33	2,900	
					1	91	1	93	3,580	
					1	179	1	181	3,670	
Do	Mar. 8	Neat.		23.0	4			4	4,460	
					12			12	4,740	
					34			34	5,580	
					98			98	5,720	
					188			188	5,450	
Do	do	Neat.		23.0	4	7	1	12	4,720	
					4	29	1	34	5,220	
					4	93	1	98	5,720	
					4	183	1	188	5,410	
Do	Apr. 26	Neat.		23.0	7			7	5,550	
					17			17	5,730	
					38			38	4,650	
					105			105	5,170	
					196			196	5,940	
Do	do	Neat.		23.0	7	9	1	17	5,160	
					7	30	1	38	4,580	
					7	97	1	105	5,170	
					7	188	1	196	5,350	
Atlas	Feb. 27	Neat.		24.0	1			1	689	
					9			9	4,130	
					33			33	5,020	
					96			96	5,560	
					183			183	5,410	

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RÉSUMÉ OF RESULTS—Continued.

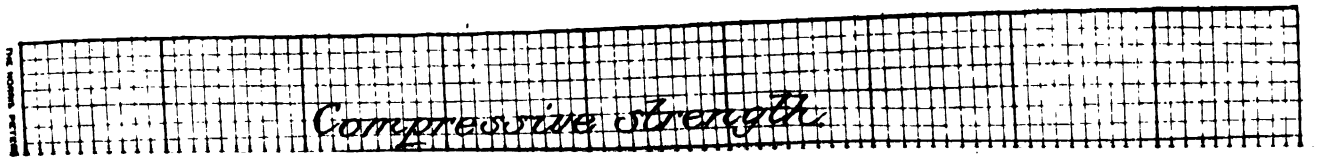
Brand of cement.	Date of manufacture.	Composition.			Time of setting in air at temperatures of—			Total age.	Mean compressive strength per square inch.	Remarks.
		Cement.	Sand.	Water.	70° F.	0° F.	70° F.			
	1902.			*Per cent.*	*Days.*	*Days.*	*Days.*	*Days.*	*Pounds.*	
Star, with plaster	Mar. 6	Neat.	.....	25.0	4	7	1	12	5,620	
		.....	.....	.....	4	31	1	36	5,190	
		.....	.....	.....	4	95	1	100	5,920	
		.....	.....	.....	4	185	1	190	6,270	
Do	Mar. 14	Neat.	.....	24.5	7	.....	.....	7	4,710	
		.....	.....	.....	15	.....	.....	15	5,820	
		.....	.....	.....	42	.....	.....	42	5,400	
		.....	.....	.....	95	.....	.....	95	6,260	
		.....	.....	.....	189	.....	.....	189	6,340	
Do	....do...	Neat.	.....	24.5	7	7	1	15	4,740	
		.....	.....	.....	7	34	1	42	5,660	
		.....	.....	.....	7	87	1	95	5,870	
		.....	.....	.....	7	182	1	190	5,790	
Do	Feb. 19	Neat	.....	24.0	1 at 20° to 26° F.	7	1	9	1,290	This lot exposed to weather 20° F. ½ hour after molding, and ranged from 20° to 26° F. the first day. Put in freezer at zero F. the next day.
		.....	.....	.....		29	1	31	1,280	
		.....	.....	.....		92	1	94	1,810	
		.....	.....	.....		180	1	182	1,700	
Star, without plaster	Feb. 17	Neat.	.....	29.5	1	.....	.....	1	338	
		.....	.....	.....	9	.....	.....	9	3,130	
		.....	.....	.....	32	.....	.....	32	4,500	
		.....	.....	.....	92	.....	.....	92	3,800	
		.....	.....	.....	184	.....	.....	184	4,400	
Do	....do...	Neat.	.....	29.5	1	7	1	9	1,400	
		.....	.....	.....	1	30	1	32	1,680	
		.....	.....	.....	1	90	1	92	2,310	
		.....	.....	.....	1	182	1	184	2,090	
Do	Feb. 28	Neat.	.....	30.0	3	.....	.....	3	1,870	
		.....	.....	.....	11	.....	.....	11	3,490	
		.....	.....	.....	35	.....	.....	35	3,100	
		.....	.....	.....	95	.....	.....	95	3,460	
		.....	.....	.....	203	.....	.....	203	3,380	

Do	Feb. 28	Neat.		30.0	3	7	1	11	2,520
					3	31	1	35	2,960
					3	91	1	95	3,170
					3	200	1	204	3,440
Whitehall	Feb. 24	Neat.		23.5	1			1	1,410
					10			10	6,100
					83			83	6,920
					99			99	5,800
					186			186	6,010
Do	do	Neat.		23.5	1	8	1	10	4,060
					1	31	1	33	4,860
					1	97	1	99	5,440
					1	184	1	186	4,960
Do	Mar. 10	Neat.		23.5	4			4	4,930
					12			12	5,400
					36			36	6,310
					99			99	6,140
					193			193	5,850
Do	do	Neat.		23.5	4	7	1	12	5,080
					4	31	1	36	5,940
					4	94	1	99	6,200
					4	189	1	194	6,080
Do	Apr. 30	Neat.		23.5	7			7	5,250
					16			16	5,330
					41			41	5,770
					101			101	6,000
					192			192	5,790
Do	do	Neat.		23.5	7	8	1	16	5,660
					7	33	1	41	5,980
					7	93	1	101	5,560
					7	184	1	192	5,090
Austin	Feb. 18	Neat.		37.5	1			1	338
					9			9	532
					32			32	748
					91			91	749
					183			183	850
Do	do	Neat.		37.5	1	7	1	9	562
					1	30	1	32	598
					1	89	1	91	673
					1	181	1	183	705

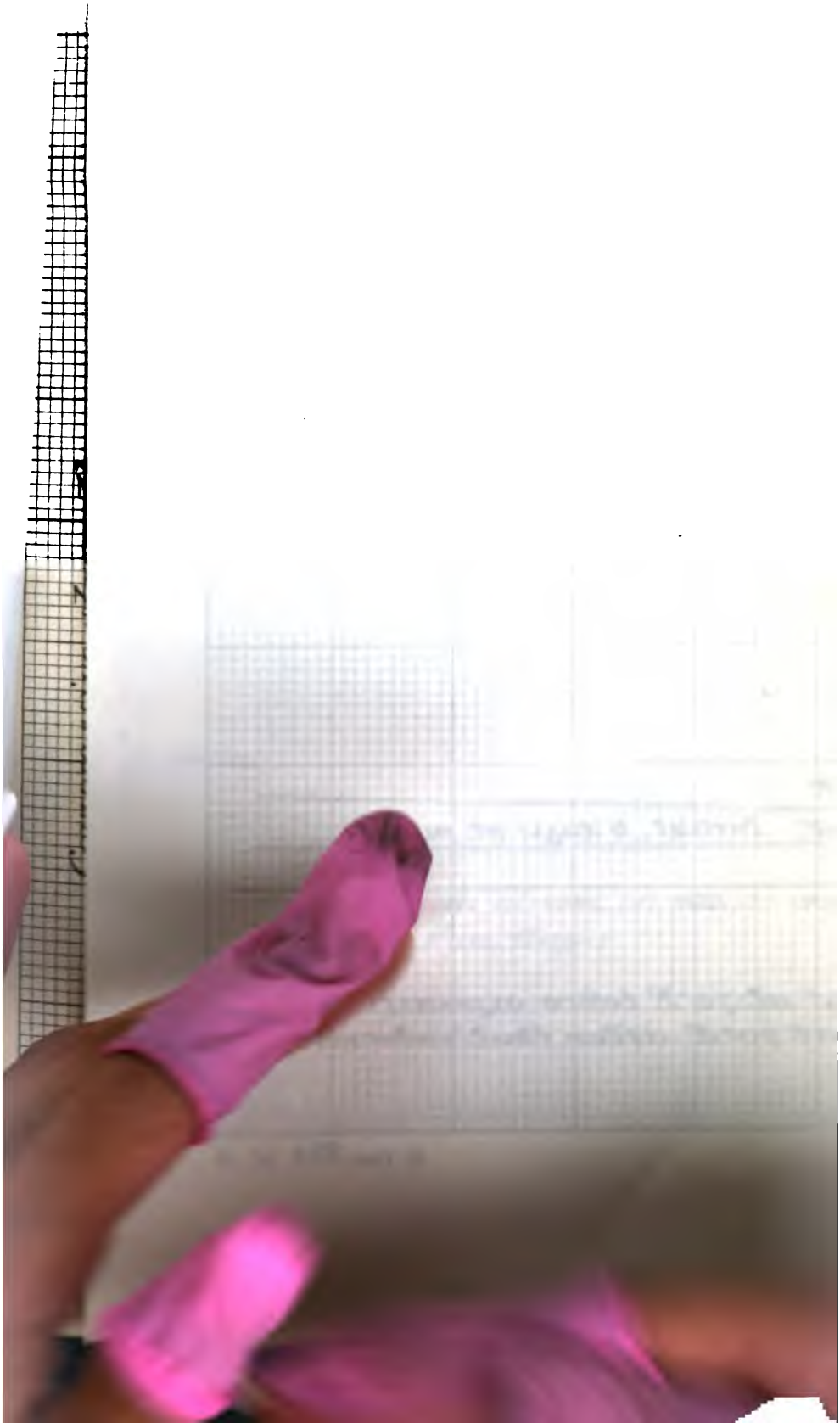
RÉSUMÉ OF RESULTS—Continued.

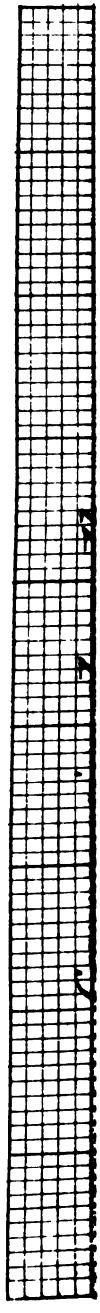
Brand of cement.	Date of manufacture.	Composition.			Time of setting in air at temperatures of—			Total age.	Mean compressive strength per square inch.	Remarks.
		Cement.	Sand.	Water.	70° F.	0° F.	70° F.			
	1902.			*Per cent.*	*Days.*	*Days.*	*Days.*	*Days.*	*Pounds.*	
Austin	Mar. 7	Neat.		34.5	4			4	407	
					12			12	559	
					35			35	798	
					99			99	1,400	
					189			189	1,620	
Do	do	Neat.		34.5	4	7	1	12	541	
					4	30	1	35	574	
					4	94	1	99	695	
					4	184	1	189	913	
Do	Mar. 15	Neat.		35.0	7			7	432	
					14			14	571	
					41			41	626	
					103			103	612	
					188			188	545	
Do	do	Neat.		35.0	7	6	1	14	488	
					7	33	1	41	585	
					7	95	1	103	603	
					7	181	1	189	909	
Do	Feb. 19	Neat.		35.0	a1	7	1	9	569	This lot exposed to freezing weather—30° F. and lower—½ hour after molding. Removed to freezer at zero F. the following day.
					a1	29	1	31	564	
					a1	92	1	94	659	
					a1	180	1	182	787	
Newark and Rosendale	Feb. 26	Neat.		38.0	1			1	201	
					9			9	606	
					31			31	1,000	
					97			97	1,250	
					184			184	1,420	
Do	do	Neat.		38.0	1	7	1	9	347	
					1	29	1	31	480	
					1	95	1	97	587	
					1	182	1	184	527	

a At 30° F. and lower.

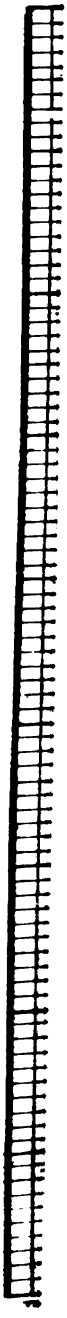

Compressive strength.

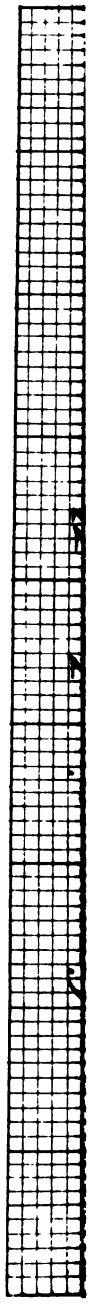
Compressive Strength.





Do	Mar. 11	Neat.		38.1	4			4	344
					14			14	598
					35			35	974
					98			98	1,220
					192			192	1,470
Do	...do...	Neat.		38.1	4	9	1	14	478
					4	30	1	35	517
					4	93	1	98	648
					4	188	1	198	659
Do	May 1	Neat.		38.1	7			7	443
					15			15	602
					40			40	1,080
					100			100	1,340
					191			191	1,820
Do	...do...	Neat.		38.1	7	7	1	15	515
					7	32	1	40	683
					7	92	1	100	786
					7	183	1	191	906





Do	Mar. 11	Neat.		38.1	4			4	344
					14			14	598
					35			35	974
					98			98	1,220
					192			192	1,470
Do	do	Neat.		38.1	4	9	1	14	478
					4	30	1	35	517
					4	93	1	98	648
					4	188	1	198	659
Do	May 1	Neat.		38.1	7			7	443
					15			15	602
					40			40	1,080
					100			100	1,840
					191			191	1,320
Do	do	Neat.		38.1	7	7	1	15	515
					7	32	1	40	683
					7	92	1	100	786
					7	183	1	191	906

Cement and Mortar Cubes.

COMPARATIVE TESTS ON MATERIAL SET IN AIR AND IN WATER.

The comparison of strength herewith made is between 2″ cubes of the same batch, one-half the number of specimens made having been set in air and one-half set in water.

A number of cubes of larger sizes were made of some brands.

The 2″ cubes were tested between flat steel platforms, one side of one platform having a spherical face to assist in the adjustment of the specimen in the testing machine. The radius of curvature of this face was 2½″. This platform was allowed to accommodate itself, bearing against a flat seat, and follow any yielding of the material.

The cubes of larger size than 2″ were tested between platforms having a ball and socket adjustment, which were locked in position at the commencement of each test after adjustment had been effected.

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, EXCEPTING THE FIRST DAY AFTER MIXING, WHICH WAS IN AIR.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Atlas	1	1	32.0	7		2.02	2.07	2.04	4.22	9,510	2,250		
						2.08	2.08	2.02	4.10	11,960	2,920		
						2.04	2.04	2.03	4.14	10,800	2,610		
						2.02	2.01	2.07	4.16	10,350	2,490		
						2.04	2.05	2.04	4.18	10,200	2,440	2,540	
Do	1	1	32.0	1	6	2.04	2.09	2.05	4.28	11,420	2,670		
						2.04	2.04	2.08	4.24	11,600	2,740		
						2.00	2.07	2.03	4.20	9,480	2,260		Defective corner.
						2.03	2.02	2.01	4.06	10,500	2,590		
						2.02	2.06	2.06	4.24	11,100	2,620	2,580	
Do	1	1	32.0	30		2.09	2.09	2.04	4.26	13,500	3,170		
						2.03	2.06	2.05	4.22	11,800	2,800		
						1.94	2.07	2.05	4.24	13,250	3,130		
						2.01	2.02	2.05	4.14	18,400	3,240		
						2.03	2.04	2.04	4.16	11,200	2,690	3,010	

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COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per. ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Lehigh	Neat.		27.0	31		2.00	2.04	1.96	4.00	22,400	5,600		
						2.01	2.06	2.01	4.14	20,100	4,860		
						2.01	2.04	2.03	4.14	16,400	3,960		
						1.96	2.04	1.99	4.06	18,500	4,560		
						1.92	2.02	2.05	4.14	15,300	3,700	4,540	
Do	Neat.		27.0	1	30	2.00	2.08	1.98	4.12	26,900	6,580		
						2.02	2.03	2.01	4.08	28,600	7,010		
						2.02	2.06	2.00	4.12	24,500	5,950		
						2.00	2.05	2.05	4.20	28,300	6,740		
						2.00	2.07	2.03	4.20	24,300	5,790	6,400	
Do	Neat.		27.0	92		2.00	2.05	2.04	4.18	16,900	4,040		
						1.99	2.06	2.00	4.12	19,100	4,640		
						1.90	2.04	2.03	4.14	16,300	3,940		
						2.01	2.02	2.06	4.16	23,700	5,700		
						1.99	2.02	2.00	4.04	16,500	4,080	4,480	
Do	Neat.		27.0	1	91	2.01	2.01	2.06	4.14	26,700	6,450		
						2.03	2.00	2.05	4.10	23,600	5,760		
						1.99	2.00	2.04	4.08	32,700	8,010		
						2.02	2.00	2.06	4.12	26,900	6,530		
						2.00	2.00	2.05	4.10	26,700	6,510	6,650	
Do	Neat.		27.0	91		3.14	3.00	3.02	9.06	49,600	5,470		
						3.00	3.08	3.04	9.36	53,300	5,690		
						3.00	3.07	3.01	9.24	51,700	5,600		
						3.00	3.08	3.05	9.24	46,800	5,060		
						3.10	3.00	3.04	9.12	47,400	5,200	5,400	
Do	Neat.		27.0	1	91	3.06	3.01	3.05	9.18	84,200	9,170		
						3.06	3.01	3.05	9.18	75,500	8,220		
						3.01	3.11	3.01	9.36	87,100	9,310		
						3.05	3.01	3.00	9.03	75,700	8,380		
						3.01	3.09	3.02	9.33	77,400	8,300	8,680	

Do	1	1	34.0	31		1.99	2.06	2.02	4.16	7,900	1,900	
						1.97	2.09	1.98	4.14	11,200	2,710	
						1.99	2.14	1.97	4.22	10,900	2,580	
						2.03	2.05	2.01	4.12	11,200	2,720	
						2.08	2.05	1.99	4.08	10,700	2,620	2,510
Do	1	1	34.0	1	30	1.99	2.04	2.04	4.16	15,400	3,700	
						2.04	2.06	2.04	4.20	18,300	4,360	
						2.02	2.06	2.08	4.18	15,700	3,760	
						2.00	2.09	2.08	4.24	19,000	4,480	
						2.01	2.08	2.01	4.18	14,800	3,540	3,970
Do	1	1	34.0	91		2.05	1.90	2.05	3.90	9,400	2,410	
						1.99	2.00	2.12	4.24	10,300	2,430	
						1.99	1.97	2.11	4.16	10,900	2,620	
						2.02	2.00	2.08	4.16	10,500	2,520	
						2.08	2.01	2.06	4.14	12,100	2,920	2,580
Do	1	1	34.0	1	90	2.03	2.04	2.05	4.18	21,400	5,120	
						2.00	2.05	2.09	4.28	20,100	4,700	
						2.01	2.00	2.06	4.12	20,600	5,000	
						1.99	2.03	2.06	4.18	19,600	4,690	
						2.02	2.06	2.03	4.18	22,400	5,360	4,970
Do	1	1	34.0	90		3.00	3.09	3.08	9.36	28,400	3,080	
						3.04	3.01	3.12	9.39	32,100	3,420	3,280
	1	1	34.0	1	90	3.09	3.02	3.08	9.30	47,600	5,120	
						3.10	3.00	3.09	9.27	53,400	5,760	5,440
Peninsular	Neat.		25.5	7		2.05	1.98	2.02	4.00	20,500	5,130	
						2.02	1.99	2.00	3.98	20,700	5,200	
						2.04	1.99	1.98	3.94	18,700	4,750	
						2.03	1.98	2.04	4.04	18,200	4,500	
						2.05	2.02	1.98	3.90	20,600	5,280	4,970
Do	Neat.		25.5	1	6	1.92	2.06	2.06	4.24	25,500	6,010	
						2.08	1.97	2.06	4.06	23,200	5,710	
						2.03	1.99	2.01	4.00	28,400	7,100	
						2.06	1.97	2.06	4.06	26,300	6,480	
						2.03	1.98	2.05	4.06	24,300	5,990	6,260
Do	Neat.		25.5	30		2.03	1.99	2.03	4.04	29,500	7,300	
						1.99	2.04	2.03	4.14	23,400	5,650	
						2.02	1.98	2.02	4.00	22,000	5,500	
						2.02	1.99	2.04	4.06	24,900	6,130	
						2.00	1.99	2.03	4.04	24,800	6,140	6,140
Do	Neat.		25.5	1	29	1.99	2.01	2.06	4.14	29,400	7,100	
						2.04	1.97	2.01	3.96	33,400	8,430	
						2.05	1.97	2.01	3.96	40,700	10,280	
						2.04	1.98	2.06	4.08	31,500	7,720	
						2.04	1.98	2.00	3.96	42,900	10,880	8,870

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Peninsular	Neat.		25.5	92		2.05	2.01	1.99	4.00	24,400	6,100		
						2.00	2.05	1.98	4.06	23,400	5,760		
						2.05	2.07	1.98	4.10	26,100	6,370	6,080	
Do	Neat.		25.5	1	91	2.05	2.07	1.99	4.12	37,400	9,080		
						1.98	1.99	2.08	4.14	40,800	9,860		
						2.03	2.04	1.92	3.92	38,200	9,740	9,560	
Do	Neat.		25.5	94		3.02	3.02	3.03	9.15	81,800	8,940		
						3.01	3.08	3.01	9.27	77,900	8,400	8,670	
Do	Neat.		25.5	3	91	3.02	3.05	3.06	9.33	113,600	12,180		1 day in air before and 2 days in air after interval in water.
						3.03	3.05	3.01	9.18	120,200	13,090		
						3.06	3.03	3.00	9.09	112,600	12,390	12,550	
Do	Neat.		25.5	94		4.07	3.96	3.96	15.68	131,300	8,370		
						4.00	4.03	4.03	16.24	136,000	8,370	8,370	
Do	Neat.		25.5	3	91	3.99	4.08	4.00	16.32	181,000	11,090		Do.
						4.05	4.00	3.98	15.92	187,000	11,750	11,420	
Do	Neat.		25.5	96		6.00	6.04	6.00	36.24	264,200	7,290		
						6.02	6.06	6.00	36.36	287,400	7,900	7,595	
Do	Neat.		25.5	5	91	5.99	6.04	5.96	36.00	358,000	9,810		1 day in air before and 4 days in air after interval in water.
						6.06	6.00	6.01	36.06	386,100	10,710	10,260	
Do	1	1	34.2	7		2.01	2.02	2.05	4.14	13,400	3,240		
						2.08	1.99	2.01	4.00	11,400	2,850		
						2.02	2.02	1.99	4.02	8,600	2,140		
						2.02	1.98	2.04	4.04	12,600	3,120		
						1.99	2.01	2.02	4.06	11,800	2,910	2,850	
Do	1	1	34.2	1	6	2.01	2.00	2.02	4.04	11,500	2,850		
						2.01	1.99	2.04	4.06	10,600	2,610		
						2.01	2.01	2.06	4.14	13,700	3,310		
						2.05	2.00	2.03	4.06	11,400	2,810		
						2.06	2.03	2.04	4.14	11,600	2,800	2,880	

Do	1	1	34.2	30		2.05	2.01	2.00	4.02	12,700	3,160		
						1.99	1.99	2.06	4.10	13,500	3,290		
						2.09	1.99	2.03	4.04	15,100	3,740	3,400	
Do	1	1	34.2	1	29	2.02	1.99	2.07	4.12	18,500	4,490		
						2.05	2.01	2.04	4.10	17,900	4,370		
						2.01	1.96	2.03	3.98	21,700	5,450		
						2.03	2.00	2.07	4.14	19,500	4,710		
						2.01	2.01	2.06	4.14	18,200	4,400	4,680	
Do	1	1	34.2	92		2.04	2.01	2.01	4.04	12,100	3,000		
						2.01	2.03	2.01	4.08	15,600	3,820	3,410	
Do	1	1	34.2	94		3.00	3.02	3.00	9.06	51,500	5,680		
						3.07	3.00	3.03	9.09	45,100	4,960	5,320	
Do	1	1	34.2	3	91	3.01	3.03	3.09	9.36	67,200	7,180		1 day in air before and 2 days in air after interval in water.
						3.01	3.00	3.06	9.18	73,100	7,960	7,570	
Do	1	1	34.2	94		4.03	3.98	3.93	15.64	76,900	4,920		
						4.13	4.00	3.89	15.56	79,900	5,130	5,025	
Do	1	1	34.2	3	91	3.98	4.06	3.97	16.12	134,500	8,340		Do.
						4.06	3.98	3.96	15.76	117,400	7,450	7,895	
Do	1	1	34.2	96		6.05	5.94	5.94	35.28	204,500	5,800		
						6.01	6.07	5.92	35.93	206,500	5,750	5,775	
Do	1	1	34.2	5	91	6.03	6.00	6.03	36.18	308,400	8,520		1 day in air before and 4 days in air after interval in water.
						6.03	6.00	6.00	36.00	301,000	8,360	8,440	
Do	1	2	48.1	7		2.06	2.04	2.04	4.16	5,220	1,250		
						2.05	2.02	2.03	4.10	5,300	1,290		
						2.06	2.01	2.04	4.10	6,350	1,550		
						2.01	2.02	2.01	4.06	5,810	1,430		
						2.01	2.03	2.06	4.18	5,660	1,350	1,870	
Do	1	2	48.1	1	6	2.05	2.04	2.01	4.10	5,500	1,340		
						2.06	2.04	2.01	4.10	5,720	1,400		
						2.03	1.99	2.04	4.06	7,480	1,840		
						2.03	2.02	2.04	4.12	5,430	1,320		
						2.03	2.04	2.08	4.24	5,500	1,300	1,440	
Do	1	2	48.1	30		2.04	2.01	2.01	4.04	5,350	1,320		
						2.00	2.03	2.01	4.08	6,450	1,580		
						1.99	2.02	2.03	4.10	5,800	1,410		
						2.04	2.01	2.03	4.08	6,700	1,640		
						2.06	2.02	2.08	4.10	6,060	1,480	1,490	
Do	1	2	48.1	1	29	2.03	2.05	2.03	4.16	9,750	2,340		
						2.01	2.03	2.05	4.16	11,420	2,750		
						2.04	2.06	2.05	4.22	11,510	2,780		
						2.01	2.02	2.02	4.08	12,000	2,940		
						2.01	2.02	2.01	4.06	12,060	2,970	2,750	

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Peninsular	1	2	48.1	93	.....	3.04	3.03	3.16	9.57	26,700	2,790	.....	
	.....	.....	.....	.....	.....	3.00	3.01	3.12	9.39	22,800	2,430	.....	
	.....	.....	.....	.....	.....	3.07	3.01	3.12	9.39	25,200	2,680	.....	
	.....	.....	.....	.....	.....	3.01	3.07	3.10	9.52	25,100	2,640	2,635	
Do	1	2	48.1	3	90	3.00	3.07	3.15	9.67	46,700	4,830	.....	1 day in air before and 2 days in air after interval in water.
	.....	.....	.....	.....	.....	3.01	3.00	3.13	9.39	51,600	5,500	.....	
	.....	.....	.....	.....	.....	3.02	3.05	3.07	9.36	41,400	4,420	.....	
	.....	.....	.....	.....	.....	3.02	3.05	3.12	9.52	49,500	5,200	4,990	
Do	1	2	48.1	93	.....	4.06	4.00	4.01	16.04	35,200	2,190	.....	
	.....	.....	.....	95	.....	4.00	4.10	3.95	16.20	46,100	2,850	2,520	
Do	1	2	48.1	5	90	4.00	4.06	3.94	16.00	75,900	4,740	.....	1 day in air before and 4 days in air after interval in water.
	.....	.....	.....	.....	.....	4.00	4.05	3.95	16.00	81,600	5,100	4,920	
Do	1	2	48.1	95	.....	6.07	6.02	6.08	36.80	111,200	3,060	.....	
	.....	.....	.....	.....	.....	6.00	6.07	6.01	36.48	109,500	3,000	3,030	
Do	1	2	48.1	5	90	6.05	6.05	6.17	37.33	171,000	4,580	.....	Do.
	.....	.....	.....	.....	.....	6.00	6.06	6.15	37.27	156,900	4,180	4,380	
Do	1	3	68.0	101	.....	3.00	3.01	3.06	9.21	15,100	1,640	.....	
	.....	.....	.....	.....	.....	3.01	3.04	3.10	9.42	13,000	1,380	.....	
	.....	.....	.....	.....	.....	3.04	3.01	3.06	9.21	16,600	1,800	.....	
	.....	.....	.....	.....	.....	3.02	3.06	3.15	9.64	11,200	1,160	.....	
	.....	.....	.....	.....	.....	3.00	3.01	3.07	9.24	14,300	1,550	1,510	
Do	1	3	68.0	5	96	3.08	3.02	3.08	9.30	30,900	3,320	.....	1 day in air before and 4 days in air after interval in water.
	.....	.....	.....	.....	.....	3.06	3.02	3.08	9.30	31,000	3,330	.....	
	.....	.....	.....	.....	.....	3.08	3.01	3.07	9.24	27,100	2,930	.....	
	.....	.....	.....	.....	.....	3.02	3.06	3.09	9.46	30,500	3,220	.....	
	.....	.....	.....	.....	.....	3.07	3.01	3.07	9.24	26,800	2,900	3,140	
Do	1	3	68.0	101	.....	3.99	4.08	3.98	16.24	27,400	1,690	.....	
	.....	.....	.....	.....	.....	4.00	4.06	3.97	16.12	26,800	1,660	1,675	
Do	1	3	68.0	5	96	4.01	4.08	3.99	16.28	51,600	3,170	.....	Do.
	.....	.....	.....	.....	.....	4.02	4.06	3.99	16.20	52,500	3,240	3,205	

Do	1	3	68.0	101		6.00	6.05	6.12	37.03	65,200	1,760	
						6.05	6.02	6.07	36.54	64,100	1,750	1,755
Do	1	3	68.0	5	96	6.00	6.04	6.07	36.66	105,400	2,880	
						6.07	6.04	6.10	36.84	113,200	3,070	2,975
Do	1	4	87.0	7		2.00	2.00	2.03	4.06	1,950	480	
						2.02	2.02	2.02	4.08	1,800	440	
						1.97	2.02	2.02	4.06	1,870	458	
						2.04	2.02	2.03	4.10	2,310	560	
						2.02	2.03	2.03	4.12	1,750	425	473
Do	1	4	87.0	1	6	2.05	1.99	2.06	4.10	2,420	590	
						2.01	2.06	2.02	4.16	2,290	550	
						2.01	2.03	2.06	4.18	2,270	543	
						2.02	2.04	2.04	4.16	2,190	526	
						1.98	1.99	2.02	4.02	2,310	575	557
Do	1	4	87.0	30		2.02	2.05	2.00	4.10	2,280	556	
						2.02	2.02	2.06	4.16	3,050	733	
						1.99	2.05	2.04	4.18	2,410	577	
						2.02	2.06	1.99	4.10	2,880	702	
						2.01	2.02	2.02	4.08	2,910	713	656
Do	1	4	87.0	1	29	2.06	2.04	2.05	4.18	4,140	990	
						2.02	2.06	1.99	4.10	3,680	898	
						2.08	2.02	2.04	4.12	4,290	1,040	
						2.01	2.07	2.01	4.16	3,630	873	950
Do	1	4	87.0	100		3.08	3.01	3.06	9.21	10,500	1,140	
						3.01	3.08	3.08	9.49	7,900	832	
						3.06	3.01	3.06	9.21	8,800	901	
						3.02	3.02	3.02	9.12	9,200	1,010	
						3.02	3.04	3.06	9.30	11,600	1,250	1,080
Do	1	4	87.0	5	95	3.01	3.07	3.08	9.46	17,400	1,840	
						3.01	3.08	3.10	9.55	19,800	2,070	
						3.02	3.02	3.12	9.42	17,900	1,900	
						3.04	3.02	3.12	9.42	17,300	1,840	
						3.01	3.05	3.11	4.49	21,000	2,210	1,970
Do	1	4	87.0	100		3.99	4.06	4.00	16.24	18,900	1,160	
						4.00	4.08	3.99	16.28	19,500	1,200	1,180
Do	1	4	87.0	5	95	4.00	4.07	4.08	16.40	32,800	1,970	
						4.00	4.02	4.01	16.12	33,400	2,070	2,020
Do	1	4	87.0	100		6.04	6.01	6.00	36.06	41,000	1,140	
						6.08	6.03	6.12	36.90	43,300	1,170	1,155
Do	1	4	87.0	5	95	6.05	6.02	6.08	36.60	53,200	1,450	
						5.98	6.09	6.10	37.15	56,800	1,530	1,490

Do

1 day in air before and 4 days in air after interval in water.

Do.

Do.

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cathedral	Neat		28.8	7		2.01	2.00	2.03	4.06	9,400	2,320		
						2.01	2.04	1.99	4.06	7,910	1,950		
						2.00	2.05	2.01	4.12	7,800	1,890		
						1.98	2.05	2.00	4.10	8,090	1,970		
						2.02	2.05	2.06	4.22	9,070	2,150	2,060	
Do	Neat.		28.8	1	6	2.02	2.06	2.03	4.18	8,950	2,140		
						2.01	2.08	1.99	4.10	7,980	1,950		
						2.04	2.07	2.02	4.18	7,260	1,740		
						2.07	2.04	2.01	4.10	7,540	1,840		
						2.00	2.02	2.06	4.16	7,600	1,880	1,900	
Do	Neat.		28.8	33		1.98	2.04	1.99	4.06	10,850	2,670		
						1.98	2.03	2.01	4.08	10,400	2,550		
						2.01	2.01	2.04	4.10	10,680	2,600		
						1.99	2.07	1.99	4.12	11,000	2,670		
						1.98	2.09	2.00	4.18	10,200	2,440	2,590	
Do	Neat.		28.8	1	32	2.01	2.05	2.01	4.12	10,000	2,430		
						2.01	2.06	2.00	4.12	9,980	2,420		
						2.04	2.01	2.02	4.06	11,700	2,880		
						2.04	2.02	2.04	4.12	11,100	2,690		
						2.01	2.05	2.05	4.20	10,800	2,570	2,600	
Do	Neat.		28.8	92		2.01	2.00	2.02	4.04	11,900	2,950		
						2.00	2.00	2.02	4.04	11,300	2,800		
						2.00	2.05	2.04	4.18	11,900	2,850		
						1.99	2.01	2.05	4.12	12,700	3,080		
						2.05	1.92	2.02	3.88	9,800	2,530	2,840	
Do	Neat.		28.8	1	91	2.01	2.08	2.03	4.12	12,800	3,110		
						2.01	2.04	2.01	4.10	15,700	3,830		
						2.02	2.01	2.05	4.12	12,200	2,960		
						1.99	2.00	2.04	4.08	12,500	3,060		
						2.01	2.02	2.05	4.14	12,500	3,020	3,200	
Do	Neat.		28.8	93		3.02	3.02	3.06	9.24	28,400	3,070	3,070	

SECOND SERIES.

COMPRESSIVE TESTS ON THE COMPARATIVE STRENGTH OF CEMENT SET IN WATER OR IN AIR, FOLLOWED BY DIFFERENT PERIODS OF EXPOSURE IN AIR OR IN WATER.

Specimens which set in water during the first interval, excepting the first day in air.

Marks.	Brand of cement.	Composition.			Age in—			Dimensions.			Sectional area.	Compressive strength.			Remarks.
		Cement	Sand.	Water.	Air.	Water.	Air.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
				Per ct.	*Day.*	*Months.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
A 14	Alpha	Neat.		24.2	1	22	1	4.02	3.99	4.03	16.08	204,600	12,720		
								4.03	3.98	4.03	16.04	196,000	12,160	12,440	
D 19	Dyckerhoff	Neat.		25.8	1	22	0	3.98	4.07	4.04	16.44	135,800	8,260		
								3.99	4.05	4.14	16.77	163,500	9,750	9,010	
		Neat.		25.8	1	22	8	3.99	4.07	4.02	16.36	112,300	6,860		
								3.98	4.03	4.06	16.36	146,200	8,940	7,900	
D 20	do	Neat.		26.8	1	22	0	4.09	4.03	3.98	16.04	143,500	8,950		
								4.12	4.03	4.00	16.12	137,000	8,500		
								3.99	4.05	4.05	16.40	168,200	10,260		
								4.06	4.02	4.00	16.08	144,200	8,970		
								4.06	4.00	4.06	16.24	146,900	9,050	9,150	
		Neat.		26.8	1	22	10	4.00	4.03	3.99	16.08	161,200	10,020		
								3.98	4.07	3.96	16.12	160,500	9,960		
								3.98	4.05	4.00	16.20	151,600	9,360		
								3.97	4.02	3.99	16.04	130,000	8,100		
								4.04	3.98	4.02	16.00	190,400	11,900	9,870	
D 19	do	Neat.		32.8	1	22	0	4.01	3.99	4.05	16.16	145,200	8,990		
								4.02	3.99	4.02	16.04	152,500	9,510		
								3.98	4.05	4.01	16.24	143,100	8,810		
								4.05	4.00	3.99	15.96	135,300	8,480		
								3.98	4.02	3.98	15.80	140,400	8,890	8,940	
		Neat.		32.8	1	22	10	4.02	4.00	4.08	16.32	164,200	10,060		
								4.08	4.00	4.07	16.28	156,300	9,600		
								3.98	4.02	4.09	16.44	102,500	9,880		
								4.04	4.02	3.98	16.00	165,900	10,370		
								4.01	4.00	4.07	16.28	156,700	9,620	9,910	

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Cathedral	1	2		2	5	2.04	2.10	2.02	4.24	3,340	788		
						2.02	2.04	2.00	4.08	3,580	877		
						1.98	2.04	2.00	4.08	2,500	613		
						2.02	2.06	2.02	4.16	2,900	697		
						1.99	2.09	2.01	4.20	2,730	650	725	
Do	1	2		30		1.99	2.08	2.02	4.20	4,300	1,020		
						2.00	2.04	2.02	4.12	3,750	910		
						1.99	2.04	2.00	4.08	2,900	711		
						1.99	2.06	2.00	4.12	2,700	655		
						2.02	2.05	2.00	4.10	3,220	785	816	
Do	1	2		2	28	2.01	2.08	2.01	4.18	4,200	1,000		
						2.02	2.04	2.01	4.10	4,600	1,120		
						2.01	2.01	2.04	4.10	4,300	1,050		
						2.02	2.07	2.03	4.20	4,350	1,040		
						2.00	2.07	2.03	4.20	4,630	1,100	1,060	
Do	1	2		98		2.02	2.04	2.03	4.14	2,900	700		
						2.03	2.04	2.04	4.16	3,400	817		
						2.00	2.01	2.04	4.10	4,850	1,180		
						2.00	2.01	2.05	4.12	3,200	777		
						2.00	1.97	2.01	3.96	3,100	783	851	
Do	1	2		1	92	2.05	2.02	2.03	4.10	5,400	1,320		
						2.05	2.03	2.06	4.18	5,200	1,240		
						2.04	2.06	2.07	4.26	5,500	1,290		
						2.00	2.03	2.05	4.16	5,500	1,320		
						2.06	2.01	2.07	4.16	6,000	1,440	1,320	
Do	1	3	63.3	7		1.95	2.06	1.98	4.08	1,390	341		
						2.04	2.02	2.02	4.08	1,620	397		
						2.00	2.02	2.04	4.12	1,100	267		
						2.00	2.03	2.00	4.16	1,450	349		
						2.04	2.03	2.00	4.06	1,300	320	335	

Do	1	3	63.3	1	6	1.97	2.08	1.98	4.12	1,430	347	1,010	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	2.07	2.01	4.16	1,150	276	959	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	1.99	1.99	1.98	4.14	1,440	365	962	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.04	2.05	1.99	4.06	1,010	248	911	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	2.06	1.99	4.10	1,020	249	908	.....	.....	.....	.....	.....	.....
Do	1	3	63.3	31	.....	2.00	2.07	2.00	4.14	1,800	435	921	.....	.....	.....	.....	.....	297
	.....	.....	.....	.....	.....	2.05	2.05	2.02	4.14	2,200	531	900	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.06	2.06	2.00	4.12	1,960	481	941	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.04	2.05	2.02	4.16	2,100	505	1,670	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.01	2.04	2.05	4.20	2,060	488	1,550	.....	.....	.....	.....	.....	488
Do	1	3	63.3	1	30	1.96	2.06	2.02	4.16	1,900	457	1,610	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.05	2.05	1.93	3.96	2,000	505	1,730	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.00	2.10	2.00	4.20	1,920	457	1,800	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.03	2.02	2.00	4.04	1,960	490	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.01	2.06	2.00	4.12	1,900	461	.....	.....	.....	.....	.....	.....	472
Do	1	3	63.3	92	.....	2.00	2.02	2.03	4.10	2,400	585	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	2.02	2.00	4.04	2,600	644	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	1.98	2.03	2.03	4.12	2,200	534	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	2.03	2.02	4.10	2,900	707	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	1.99	2.03	4.04	2,300	569	.....	.....	.....	.....	.....	.....	606
Do	1	3	63.3	1	91	2.00	2.02	2.03	4.10	2,100	512	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	2.00	2.04	4.08	2,500	613	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.02	2.01	2.03	4.08	3,300	809	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.01	2.07	2.02	4.18	2,400	574	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.06	1.96	2.00	3.90	2,400	615	.....	.....	.....	.....	.....	.....	625
Do	1	3	63.3	98	.....	3.03	3.00	3.05	9.15	8,500	929	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	3.00	3.02	3.04	9.30	8,280	888	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	3.02	3.05	3.08	9.24	8,700	942	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	3.02	3.06	3.07	9.39	9,500	1,010	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	3.00	3.00	3.15	9.45	6,000	685	.....	.....	.....	.....	.....	.....	881
Do	1	3	63.3	2	91	3.01	3.04	3.07	9.46	9,600	1,010	.....	1 day in air before and 1 day in air after interval in water.					
	.....	.....	.....	.....	.....	3.10	3.00	3.06	9.13	8,800	959	.....						
	.....	.....	.....	.....	.....	3.02	3.07	3.06	9.46	9,100	962	.....						
	.....	.....	.....	.....	.....	3.00	3.01	3.15	9.48	8,640	911	.....						
	.....	.....	.....	.....	.....	3.01	3.06	3.06	9.38	8,500	908	.....						950
Do	1	3	63.3	93	.....	4.07	4.00	3.99	15.96	14,700	921	.....	.....	.....	.....	.....	.....	921
Do	1	3	63.3	2	91	4.06	4.00	4.00	16.00	14,400	900	.....	Do.					
	.....	.....	.....	.....	.....	4.09	4.00	4.01	16.04	15,100	941	.....						921
Silica	.....	.....	25.8	7	.....	2.00	2.09	2.01	4.20	7,000	1,670	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.00	2.04	2.00	4.26	6,620	1,550	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	1.96	2.13	1.96	4.16	6,700	1,610	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	2.01	2.08	1.99	4.14	7,170	1,730	.....	.....	.....	.....	.....	.....	.....
	.....	.....	.....	.....	.....	1.97	2.08	1.98	4.12	7,400	1,800	.....	.....	.....	.....	.....	.....	1,670

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Silica	Neat.		25.8	1	6	1.99	2.08	2.08	4.22	8,600	2,040		
						2.01	2.04	1.98	4.04	7,590	1,880		
						2.05	2.07	1.99	4.12	7,150	1,740		
						2.08	2.09	2.00	4.18	7,460	1,780		
						2.01	2.09	1.99	4.16	8,220	1,980	1,880	
Do	Neat.		25.8	31		1.97	2.01	2.03	4.16	8,400	2,020		
						2.03	2.03	2.00	4.06	9,450	2,330		
						2.05	2.05	1.97	4.04	8,800	2,180		
						2.02	2.05	2.04	4.18	8,700	2,080		
						1.96	2.05	1.96	4.02	6,900	1,720	2,070	
Do	Neat.		25.8	1	30	1.99	2.06	1.99	4.10	11,300	2,760		
						2.00	2.05	2.02	4.14	11,900	2,870		
						2.02	2.10	2.04	4.28	12,600	2,940		
						2.02	2.10	2.02	4.24	11,500	2,710		
						1.99	2.06	2.01	4.14	11,900	2,870	2,830	
Do	Neat.		25.8	93		1.94	1.99	2.06	4.10	9,600	2,340		
						1.98	2.00	2.04	4.08	10,200	2,500		
						1.88	2.02	2.03	4.10	10,300	2,510		
						2.01	1.97	2.03	4.00	9,050	2,260		
						2.03	1.99	2.02	4.02	10,100	2,510	2,420	
Do	Neat.		25.8	1	92	2.02	2.00	2.10	4.20	13,200	3,140		
						2.01	2.00	2.11	4.22	12,700	3,010		
						2.04	2.01	2.07	4.16	13,000	2,130		
						2.01	2.00	2.07	4.14	12,900	3,120		
						2.00	2.00	2.07	4.14	13,100	3,160	3,110	
Do	Neat.		25.8	93		3.00	3.08	3.13	9.64	18,300	1,900		
						3.00	3.06	3.06	9.36	18,500	1,980		
						3.07	3.00	3.07	9.21	18,200	1,980	1,950	
Do	Neat.		25.8	1	92	3.02	3.06	3.14	9.61	33,200	3,450		
						3.01	3.09	3.11	9.61	33,100	3,440		
						3.01	3.08	3.07	9.46	32,900	3,480	3,460	
Do	Neat.		25.8	93		3.97	4.05	3.99	16.16	30,400	1,880	1,880	

Do	Neat.		25.8	1	92	4.03	3.99	3.98	15.88	42,300	2,660	
						4.00	4.07	4.06	16.52	48,400	2,930	2,800
Do	1	1	32.0	6		1.97	2.06	2.01	4.14	4,240	1,020	
						2.02	2.03	1.99	4.04	4,410	1,090	
						2.00	2.09	1.98	4.14	3,830	925	
						1.98	2.05	2.00	4.10	3,510	856	
						2.00	2.05	1.98	4.06	3,320	818	942
Do	1	1	32.0	1	5	2.04	2.04	2.01	4.10	4,810	1,170	
						2.04	2.06	2.01	4.14	4,480	1,080	
						2.03	2.09	2.01	4.20	4,120	981	
						1.93	2.11	2.06	4.35	4,410	1,010	
						2.01	2.04	2.01	4.10	4,870	1,190	1,090
Do	1	1	32.0	32		1.98	2.05	1.99	4.08	6,040	1,480	
						2.06	2.05	2.02	4.14	5,500	1,330	
						1.99	2.02	2.01	4.06	6,700	1,650	
						2.04	2.05	2.03	4.16	5,900	1,420	
						2.02	2.02	2.05	4.14	5,900	1,430	1,460
Do	1	1	32.0	1	31	2.00	2.05	2.04	4.18	8,320	1,990	
						1.99	2.05	2.06	4.22	8,400	1,990	
						2.01	2.06	2.04	4.20	7,600	1,810	
						2.01	2.04	2.01	4.10	8,100	1,980	
						2.01	2.03	2.04	4.14	7,500	1,810	1,920
Do	1	1	32.0	92		2.02	2.02	2.07	4.18	6,700	1,600	
						1.98	2.03	2.06	4.18	7,100	1,700	
						1.96	2.02	2.08	4.20	6,600	1,570	
						2.00	2.01	2.04	4.10	6,900	1,680	
						2.00	2.06	2.05	4.22	6,300	1,490	1,610
Do	1	1	32.0	1	91	2.00	2.02	2.06	4.16	9,300	2,240	
						2.00	2.00	2.06	4.12	10,100	2,450	
						2.01	2.02	2.08	4.20	10,300	2,450	
						1.90	2.05	2.07	4.24	9,300	2,190	
						2.00	2.01	2.12	4.26	10,100	2,870	2,340
Do	1	1	32.0	92		3.04	3.02	3.10	9.36	13,200	1,410	
						3.00	3.07	3.05	9.36	13,700	1,460	1,440
Do	1	1	32.0	1	91	3.02	3.05	3.11	9.49	27,400	2,890	
						3.01	3.09	3.12	9.64	28,800	2,470	2,680
Do	1	2	44.0	5		1.99	2.06	1.98	4.08	1,710	419	
						2.03	2.05	1.98	4.06	1,400	345	
						2.02	2.09	2.00	4.18	1,710	409	
						2.05	2.07	2.00	4.14	1,610	389	
						2.00	2.06	2.04	4.20	1,550	369	386

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Silica	1	2	44.0	1	4	2.05	2.03	1.91	3.88	1,550	399	.....	
	.....	.....	.....	.....	.....	2.05	2.04	1.99	4.06	1,980	488	.....	
	.....	.....	.....	.....	.....	2.05	2.01	2.00	4.02	1,900	473	.....	
	.....	.....	.....	.....	.....	2.02	2.05	1.99	4.08	1,480	363	.....	
	.....	.....	.....	.....	.....	2.05	2.07	2.03	4.20	1,670	398	424	
Do	1	2	44.0	31	.....	2.01	2.07	1.98	4.10	2,850	695	.....	
	.....	.....	.....	.....	.....	2.01	2.09	2.04	4.13	2,900	702	.....	
	.....	.....	.....	.....	.....	2.01	2.07	2.01	4.16	3,300	793	.....	
	.....	.....	.....	.....	.....	2.02	2.03	2.01	4.08	2,670	654	.....	
	.....	.....	.....	.....	.....	2.01	2.06	2.01	4.14	2,890	698	708	
Do	1	2	44.0	1	30	2.03	2.04	1.90	3.88	3,760	969	.....	
	.....	.....	.....	.....	.....	1.92	2.04	2.03	4.14	3,100	749	.....	
	.....	.....	.....	.....	.....	1.98	2.08	1.99	4.14	3,800	918	.....	
	.....	.....	.....	.....	.....	2.05	2.03	2.01	4.08	3,350	821	.....	
	.....	.....	.....	.....	.....	2.06	2.05	1.92	3.94	3,710	942	880	
Do	1	2	44.0	92	.....	1.98	2.00	2.08	4.16	4,100	986	.....	
	.....	.....	.....	.....	.....	2.00	2.01	2.04	4.10	3,700	902	.....	
	.....	.....	.....	.....	.....	2.04	1.94	2.05	3.98	2,900	729	.....	
	.....	.....	.....	.....	.....	2.02	2.00	2.06	4.12	3,200	777	.....	
	.....	.....	.....	.....	.....	2.01	2.02	2.08	4.20	3,600	857	850	
Do	1	2	44.0	1	91	1.99	2.06	1.97	4.06	4,500	1,110	.....	
	.....	.....	.....	.....	.....	2.10	2.04	2.03	4.14	5,000	1,210	.....	
	.....	.....	.....	.....	.....	2.00	1.99	2.07	4.12	4,550	1,100	.....	
	.....	.....	.....	.....	.....	2.01	2.10	2.06	4.33	5,400	1,250	.....	
	.....	.....	.....	.....	.....	2.00	2.01	2.08	4.18	3,860	923	1,120	
Do	1	2	44.0	92	.....	3.07	3.00	3.05	9.15	7,620	833	.....	
	.....	.....	.....	.....	.....	3.03	3.01	3.07	9.24	7,040	762	.....	
	.....	.....	.....	.....	.....	3.01	3.05	3.10	9.45	8,100	857	.....	
	.....	.....	.....	.....	.....	3.04	3.00	3.06	9.18	9,400	1,020	868	

Do	1	2	44.0	1	91	3.04	3.03	3.06	9.27	13,100	1,410	
						3.03	3.02	3.05	9.21	12,800	1,390	
						3.01	3.06	3.01	9.21	14,300	1,550	
						3.02	3.01	3.05	9.18	13,300	1,450	
						3.00	3.00	3.07	9.21	17,500	1,900	
						3.01	3.07	3.06	9.39	13,900	1,480	1,530
Do	1	2	44.0	92		3.98	4.04	4.04	16.32	18,500	1,130	
						3.98	4.06	3.99	16.20	17,600	1,090	
						3.97	4.03	3.95	15.92	17,200	1,080	
						4.02	3.99	4.03	16.08	15,800	983	1,070
Do	1	2	44.0	1	91	4.01	4.06	4.00	16.24	26,700	1,640	
						3.99	4.10	4.00	16.40	24,400	1,490	
						4.09	3.99	4.01	16.00	26,300	1,640	
						4.07	4.00	4.00	16.00	24,300	1,520	1,570
Do	1	3	58.0	4		1.99	2.05	2.05	4.20	600	143	
						1.96	2.04	1.98	4.04	480	119	
						1.96	2.06	2.04	4.20	590	140	
						2.01	2.05	2.04	4.18	560	134	
						2.00	2.06	2.04	4.20	470	112	130
Do	1	3	58.0	1	3	2.05	2.00	2.06	4.12	540	131	
						2.05	1.90	2.06	3.91	420	107	
						2.05	1.94	2.04	3.96	560	141	
						1.97	2.01	2.08	4.18	550	132	
						2.01	2.03	2.08	4.22	630	149	132
Do	1	3	58.0	31		2.00	2.04	2.03	4.14	1,000	242	
						2.00	2.03	1.99	4.04	830	205	
						1.95	2.03	1.97	4.00	700	175	
						2.03	2.06	2.01	4.14	990	239	
						1.99	2.06	2.02	4.16	980	236	219
Do	1	3	58.0	1	30	2.02	2.05	2.03	4.16	1,550	373	
						2.01	2.10	2.02	4.24	1,400	330	
						1.99	2.03	1.99	4.04	1,580	379	
						2.05	2.06	2.01	4.14	1,400	338	
						2.00	2.12	1.99	4.22	1,600	379	360
Do	1	3	58.0	94		2.04	1.98	2.07	4.10	1,200	293	
						2.07	2.00	2.02	4.04	1,200	297	
						2.06	2.01	2.05	4.12	1,200	291	
						1.97	2.00	2.06	4.12	980	238	
						2.00	2.02	2.06	4.16	1,700	409	306
Do	1	3	58.0	1	93	2.01	2.00	2.07	4.14	2,400	580	
						2.02	1.99	2.08	4.14	2,000	483	
						2.05	2.03	2.03	4.12	2,500	607	
						2.00	1.99	2.07	4.12	2,300	558	
						2.05	2.00	2.07	4.14	2,600	628	571

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Silica	1	3	58.0	93	.....	3.00	3.02	3.08	9.30	4,700	505	.....	
	.....	.....	.....	.....	.....	3.00	3.00	3.05	9.15	4,600	503	.....	
	.....	.....	.....	.....	.....	3.05	3.00	3.06	9.18	6,500	708	.....	
	.....	.....	.....	.....	.....	3.05	3.00	3.07	9.21	5,800	630	587	
Do	1	3	58.0	1	93	3.06	3.02	3.09	9.33	8,500	911	.....	
	.....	.....	.....	.....	.....	3.02	3.03	3.04	9.21	8,600	934	.....	
	.....	.....	.....	.....	.....	3.01	3.07	3.08	9.46	9,500	1,000	.....	
	.....	.....	.....	.....	.....	3.02	3.00	3.10	9.30	8,300	892	934	
Do	1	3	58.0	93	.....	4.03	3.99	4.03	16.08	11,300	703	.....	
	.....	.....	.....	.....	.....	3.97	4.03	4.00	16.12	12,100	751	.....	
	.....	.....	.....	.....	.....	4.07	3.97	4.02	15.96	9,800	614	.....	
	.....	.....	.....	.....	.....	3.97	4.05	4.01	16.24	8,100	499	.....	
	.....	.....	.....	.....	.....	4.05	3.99	4.06	16.20	8,400	519	617	
Do	1	3	58.0	1	93	3.99	4.05	4.16	16.85	15,200	902	.....	
	.....	.....	.....	.....	.....	4.07	3.98	4.11	16.36	11,600	709	.....	
	.....	.....	.....	.....	.....	4.02	3.99	4.05	16.16	12,900	798	.....	
	.....	.....	.....	.....	.....	3.99	4.05	4.06	16.44	14,000	852	.....	
	.....	.....	.....	.....	.....	4.06	3.96	3.98	15.76	13,400	850	822	
Newark and Rosendale.	Neat.	.....	37.6	7	.....	2.01	2.08	2.05	4.26	2,000	469	.....	
	.....	.....	.....	.....	.....	2.08	2.02	1.99	4.02	2,190	545	.....	
	.....	.....	.....	.....	.....	2.05	2.04	2.09	4.26	1,990	467	.....	
	.....	.....	.....	.....	.....	2.03	2.01	2.05	4.12	2,010	488	.....	
	.....	.....	.....	.....	.....	2.04	2.00	2.05	4.10	2,150	524	499	
Do	Neat.	.....	37.6	1	6	2.08	2.06	2.03	4.18	1,710	409	.....	
	.....	.....	.....	.....	.....	1.99	2.04	2.00	4.08	1,400	343	.....	
	.....	.....	.....	.....	.....	2.02	2.03	2.05	4.16	1,550	373	.....	
	.....	.....	.....	.....	.....	2.03	2.03	2.07	4.20	1,590	379	.....	
	.....	.....	.....	.....	.....	2.04	2.03	2.02	4.10	1,610	393	379	
Do	Neat.	.....	37.6	39	.....	2.01	2.09	2.03	4.24	4,400	1,040	.....	
	.....	.....	.....	.....	.....	2.04	2.06	2.03	4.18	5,000	1,200	.....	
	.....	.....	.....	.....	.....	2.01	2.05	2.03	4.16	4,500	1,080	.....	
	.....	.....	.....	.....	.....	2.01	2.04	2.04	4.16	3,980	957	.....	
	.....	.....	.....	.....	.....	2.00	2.06	1.98	4.08	3,600	883	1,030	

Do	Neat.		37.6	1	38	2.02	2.04	2.02	4.12	6,000	1,460	
						2.02	2.04	2.09	4.26	6,100	1,430	
						2.04	2.05	2.10	4.31	5,600	1,300	
						2.01	2.05	2.04	4.18	6,700	1,600	
						2.02	2.06	2.04	4.20	6,910	1,650	1,490
Do	Neat.		37.6	93		2.06	2.03	2.07	4.20	7,100	1,690	
						2.01	2.01	2.08	4.18	6,740	1,610	
						2.06	2.05	2.06	4.22	5,700	1,350	
						2.02	2.04	2.07	4.22	6,050	1,430	
						2.03	2.07	2.07	4.28	5,400	1,260	1,470
Do	Neat.		37.6	1	92	2.06	2.04	2.07	4.22	6,900	1,640	
						1.95	2.07	2.02	4.18	9,600	2,300	
						2.06	2.06	2.05	4.22	8,200	1,940	
						2.05	2.03	2.08	4.22	9,300	2,320	
						2.02	2.03	2.08	4.22	7,500	1,780	2,000
Do	Neat.		37.6	95		3.00	3.06	3.11	9.52	12,900	1,360	
						3.05	3.00	3.10	9.30	11,900	1,280	
						3.00	3.06	3.10	9.49	12,400	1,310	
						3.08	3.01	3.17	9.54	14,100	1,480	1,360
Do	Neat.		37.6	3	92	3.02	3.07	3.14	9.64	24,300	2,520	
						3.02	3.07	3.11	9.55	21,800	2,280	
						3.06	3.05	3.14	9.58	23,600	2,460	
						3.02	3.08	3.15	9.70	24,600	2,540	2,450
Do	Neat.		37.6	96		4.00	4.07	4.06	16.52	24,300	1,470	
						3.97	4.07	4.02	16.36	20,100	1,280	1,350
Do	Neat.		37.6	4	92	4.00	4.05	4.02	16.28	37,600	2,310	
						4.04	3.99	4.01	16.00	38,500	2,410	2,360
Do	Neat.		37.6	96		5.97	6.04	6.19	37.39	46,700	1,250	1,250
Do	Neat.		37.6	4	92	6.05	6.00	6.19	37.14	75,100	2,020	2,020
Do	Neat.		37.6	186		2.00	2.03	2.07	4.20	9,300	2,210	
						2.02	2.02	2.06	4.16	8,400	2,020	
						2.00	2.02	2.06	4.16	7,650	1,840	
						2.03	2.01	2.06	4.14	7,500	1,810	
						2.04	2.06	2.08	4.28	8,200	1,920	1,960
Do	Neat.		37.6	1	183	2.02	2.06	2.07	4.26	10,900	2,560	
						2.06	2.09	2.06	4.28	9,200	2,150	
						2.03	2.05	2.05	4.20	9,100	2,170	
						2.03	2.06	2.09	4.31	9,400	2,180	
						2.03	2.02	2.04	4.12	9,650	2,340	2,280

1 day in air before and 2 days in air after interval in water.

1 day in air before and 3 days in air after interval in water.

Do.

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Obelisk	Neat.		40.5	6		2.03	2.04	2.04	4.16	3,900	938		
						2.00	2.01	2.05	4.12	3,150	765		
						1.98	2.03	2.01	4.08	3,380	826		
						2.01	2.02	2.05	4.14	3,780	913		
						1.98	2.00	1.99	3.98	3,670	922	873	
Do	Neat.		40.5	1	5	2.01	1.99	2.03	4.02	2,680	665		
						2.05	2.00	2.02	4.04	2,490	618		
						1.99	2.02	2.00	4.04	3,000	743		
						2.01	2.01	2.02	4.06	2,710	667		
						2.01	2.06	2.07	4.26	2,700	634	665	
Do	Neat.		40.5	38		2.01	2.00	1.99	3.98	6,720	1,690		
						2.02	2.02	2.04	4.12	6,400	1,550		
						2.00	2.02	2.00	4.04	6,020	1,490		
						2.02	2.01	2.06	4.14	6,200	1,500		
						2.00	2.01	2.00	4.02	4,700	1,170	1,480	
Do	Neat.		40.5	1	37	2.03	2.03	2.01	4.08	5,100	1,250		
						2.03	2.05	2.00	4.10	5,300	1,290		
						2.03	2.07	1.99	4.12	5,500	1,330		
						1.98	1.99	2.06	4.10	5,920	1,440		
						2.00	1.99	1.98	3.94	5,600	1,420	1,350	
Do	Neat.		40.5	92		1.97	1.99	2.00	3.98	6,400	1,610		
						2.03	2.00	2.00	4.00	8,000	2,000		
						1.98	2.02	2.01	4.06	9,400	2,320		
						1.98	1.98	1.99	3.94	7,100	1,800		
						1.98	1.99	2.00	3.98	8,300	2,090	1,960	
Do	Neat.		40.5	1	91	2.05	2.00	2.01	4.02	7,400	1,840		
						2.08	1.95	2.00	3.90	8,100	2,080		
						2.05	2.08	2.01	4.08	10,000	2,450		
						1.99	2.00	2.00	4.00	9,300	2,330		
						2.07	2.05	2.04	4.18	10,500	2,510	2,240	

Do	Neat.		40.5	94		3.00	3.02	3.01	9.09	18,900	2,080	
						3.00	3.01	2.99	9.00	19,800	2,200	
						3.00	3.01	2.99	9.00	19,100	2,120	
						3.02	3.00	3.00	9.00	17,600	1,960	
						3.01	3.04	3.00	9.12	19,700	2,160	2,100
Do	Neat.		40.5	3	91	3.06	3.03	3.02	9.15	23,100	2,520	1 day in air before and 2 days in air after interval in water.
				4	91	3.02	3.08	3.00	9.24	24,700	2,670	1 day in air before and 3 days in air after interval in water.
						3.02	3.10	2.97	9.21	24,800	2,690	
						3.04	3.02	3.07	9.27	24,100	2,600	
						3.04	3.05	2.99	9.12	23,200	2,540	2,600
Do	Neat.		40.5	95		4.03	3.97	3.90	15.48	31,200	2,020	
						3.98	4.05	3.91	15.84	35,600	2,250	2,135
Do	Neat.		40.5	4	91	4.05	4.00	3.98	15.92	43,600	2,740	Do.
						4.09	4.00	3.97	15.88	41,400	2,610	2,675
Do	Neat.		40.5	185		1.99	1.98	2.00	3.96	10,600	2,680	
						1.98	1.99	2.03	4.04	9,500	2,350	
						1.98	2.01	2.00	4.02	9,750	2,430	
						2.04	2.00	2.01	4.02	9,820	2,440	
						1.97	2.00	2.01	4.02	9,700	2,410	2,460
Do	Neat.		40.5	1	182	2.04	2.03	2.02	4.10	10,500	2,560	
						2.01	2.04	2.05	4.18	11,600	2,780	
						2.03	2.03	2.01	4.18	10,300	2,460	
						2.02	2.02	2.01	4.06	10,100	2,490	
						2.06	2.04	2.03	4.14	10,600	2,560	2,570
Do	1	1	42.0	7		2.04	2.04	2.02	4.12	2,710	658	
						2.01	2.03	2.02	4.10	2,400	585	
						2.02	2.05	2.09	4.28	2,980	696	
						2.07	2.03	1.93	3.92	2,900	740	
						2.04	2.02	2.01	4.06	2,730	672	670
Do	1	1	42.0	1	6	2.01	2.03	2.00	4.06	2,400	591	
						2.02	2.07	2.02	4.18	2,420	579	
						2.03	2.03	2.02	4.10	2,280	556	
						2.03	2.05	2.03	4.16	2,450	589	
						2.02	2.04	2.03	4.14	2,200	531	569
Do	1	1	42.0	35		2.06	2.03	2.01	4.18	4,500	1,080	
						2.02	2.05	2.03	4.26	4,450	1,040	
						2.05	2.03	2.05	4.16	5,550	1,330	
						2.10	2.02	2.01	4.06	4,100	1,010	
						2.02	2.01	2.05	4.12	5,120	1,240	1,140

COMPRESSION TESTS IN WHICH ONE-HALF OF THE BATCH OF SPECIMENS WAS SET IN AIR AND ONE-HALF IN WATER, ETC.—Continued.

Brand of cement.	Composition.			Age in—		Dimensions.			Sectional area.	Compressive strength.			Remarks.
	Cement.	Sand.	Water.	Air.	Water.	Height.	Compressed surface.			Total.	Per square inch.	Mean.	
			Per. ct.	*Days.*	*Days.*	*Inches.*	*Inches.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
Obelisk	1	1	42.0	1	34	2.02	1.98	2.02	4.00	3,900	975		
						1.95	2.02	2.04	4.12	4,200	1,020		
						2.03	2.03	1.93	3.92	4,800	1,220		
						2.01	2.00	2.03	4.06	4,400	1,080		
						2.01	2.03	2.05	4.16	3,900	938	1,050	
Do	1	1	42.0	92		2.04	2.02	2.01	4.06	5,100	1,260		
						2.00	1.98	2.06	4.08	7,300	1,790		
						2.02	2.02	2.01	4.06	5,100	1,260		
						2.01	2.06	2.06	4.24	5,600	1,320		
						2.05	2.01	2.04	4.10	5,300	1,290	1,380	
Do	1	1	42.0	1	91	2.00	2.05	2.05	4.20	6,600	1,570		
						2.00	2.02	2.08	4.20	6,400	1,520		
						2.05	2.02	2.06	4.16	7,200	1,730		
						2.02	2.02	2.04	4.12	7,000	1,700		
						2.01	2.01	2.01	4.04	6,400	1,580	1,620	
Do	1	1	42.0	92		3.02	3.06	3.12	9.55	15,400	1,610		
						3.01	3.01	3.12	9.39	15,100	1,610		
						3.02	3.00	3.11	9.33	12,400	1,330	1,520	
Do	1	1	42.0	1	91	3.02	3.11	3.14	9.77	16,200	1,660		
						3.02	3.01	3.12	9.39	16,500	1,760		
						3.03	3.02	3.15	9.51	17,100	1,800		
						3.02	3.11	3.13	9.73	17,600	1,810	1,760	

CEMENT AND MORTAR CUBES.

Summary of results on 2-inch cubes. One-half of each batch set in air, one-half in water.

(Specimens set in water were set the first day after mixing in air.)

Brand.	Composition.			Age.	Mean compressive strength.	
	Cement.	Sand.	Water.		Set in air, per square inch.	Set in water, per square inch.
			Per cent.		*Pounds.*	*Pounds.*
Atlas	1	1	32.0	1 week	2,540	2,580
				1 month	3,010	3,470
				3 months	3,390	4,550
Lehigh	Neat.		27.0	1 month	4,540	6,400
				3 months	4,480	6,650
Do	1	1	34.0	1 month	2,510	3,970
				3 months	2,580	4,970
Peninsular	Neat.		25.5	1 week	4,970	6,260
				1 month	6,140	8,870
				3 months	6,080	9,560
Do	1	1	34.2	1 week	2,850	2,880
				1 month	3,400	4,680
				3 months	3,410	
Do	1	2	48.1	1 week	1,370	1,440
				1 month	1,490	2,750
Do	1	4	87.0	1 week	473	557
				1 month	656	950
Cathedral	Neat.		28.8	1 week	2,060	1,900
				1 month	2,590	2,600
				3 months	2,840	3,200
Do	1	1	36.6	1 week	1,350	[a] 1,340
				1 month	2,140	[a] 2,130
				3 months	2,190	2,410
Do	1	2		1 week	718	[b] 725
				1 month	816	[b] 1,060
				3 months	851	1,320
Do	1	3	63.3	1 week	335	297
				1 month	488	472
				3 months	608	625
Silica	Neat.		25.8	1 week	1,670	1,880
				1 month	2,070	2,830
				3 months	2,420	3,110
Do	1	1	32.0	6 days	942	1,090
				1 month	1,460	1,920
				3 months	1,610	2,340
Do	1	2	44.0	5 days	386	424
				1 month	424	708
				3 months	850	1,120
Do	1	3	58.0	4 days	130	132
				1 month	219	360
				3 months	306	571
Newark and Rosendale	Neat.		37.6	1 week	499	379
				39 days	1,030	1,490
				3 months	1,490	2,000
				6 months	1,960	2,280
Obelisk	Neat.		40.5	6 days	873	665
				38 days	1,480	1,350
				3 months	1,960	2,240
				6 months	2,460	2,570
Do	1	1	42.0	1 week	670	569
				35 days	1,140	1,050
				3 months	1,380	1,620

[a] 4 days in air. [b] 2 days in air.

Cement Cubes.

Material set in air or in water followed by different periods of exposure under reversed conditions.

FIRST SERIES.

Two batches of cubes were made for this series of tests. The specimens of one batch were set in air initial periods of time, from one week to three months, after which they were placed in water, where they remained until the time of testing.

In the other batch the conditions were reversed and an initial period in water was followed by a period in air. Also specimens from each batch set the full time in air and in water.

Tests were made when the material was four months old.

TESTS OF CUBES SET IN AIR, AND THOSE SET IN AIR FOLLOWED BY AN INTERVAL IN WATER.

Marks, ☆ J. 23.
Composition, Star cement, without plaster, neat.
Water used in gauging, 24.8 per cent of cement.

Age in—					Dimensions.			Sectional area.	Compressive strength.			Remarks.
Air.			Water.		Height.	Compressed surface.			Total.	Per square inch.	Mean.	
Mos.	*W'ks.*	*Days.*	*Mos.*	*W'ks.*	*Ins.*	*Ins.*	*Ins.*	*Sq. in.*	*Pounds.*	*Pounds.*	*Pounds.*	
.....	1	1	.....	.....	2.06	2.01	2.03	4.08	11,570	2,840	.....	
.....	.....	.....	.....	.....	2.05	2.01	2.05	4.12	13,580	3,300	.....	
.....	.....	.....	.....	.....	2.01	2.01	2.00	4.02	11,800	2,940	.....	
.....	.....	.....	.....	.....	2.02	2.03	2.03	4.12	11,400	2,770	.....	
.....	.....	.....	.....	.....	2.04	2.05	2.03	4.16	12,900	3,100	2,990	
.....	2	.....	.....	.....	2.01	1.99	2.04	4.06	13,500	3,330	.....	
.....	.....	.....	.....	.....	2.03	2.03	2.04	4.14	12,790	3,090	.....	
.....	.....	.....	.....	.....	2.03	2.03	2.05	4.16	12,300	2,960	.....	
.....	.....	.....	.....	.....	1.99	1.97	2.00	3.94	12,970	3,290	.....	
.....	.....	.....	.....	.....	2.03	1.99	2.04	4.06	12,960	3,180	3,170	
.....	3	.....	.....	.....	2.00	2.03	2.06	4.18	13,650	3,270	.....	
.....	.....	.....	.....	.....	2.00	2.01	1.99	4.00	14,030	3,510	.....	
.....	.....	.....	.....	.....	2.00	2.00	2.00	4.00	12,000	3,000	.....	
.....	.....	.....	.....	.....	2.00	2.02	2.02	4.06	13,800	3,380	.....	
.....	.....	.....	.....	.....	2.05	2.01	2.06	4.14	14,350	3,450	3,320	
.....	3	2	.....	.....	2.00	2.00	2.02	4.04	16,500	4,080	.....	
.....	.....	.....	.....	.....	2.02	2.02	2.03	4.10	18,360	4,480	.....	
.....	.....	.....	.....	.....	2.04	2.09	2.00	4.18	13,400	3,210	.....	
.....	.....	.....	.....	.....	2.00	2.05	2.06	4.22	14,320	3,390	.....	
.....	.....	.....	.....	.....	2.00	2.06	2.04	4.18	15,700	3,760	3,780	
2	.....	.....	.....	.....	1.99	1.97	2.02	3.98	15,200	3,820	.....	
.....	.....	.....	.....	.....	2.01	1.94	2.02	3.92	13,700	3,490	.....	
.....	.....	.....	.....	.....	2.05	2.02	2.03	4.10	12,900	3,150	.....	
.....	.....	.....	.....	.....	2.04	2.02	2.03	4.10	16,900	4,120	.....	
.....	.....	.....	.....	.....	2.04	2.03	2.04	4.14	14,600	3,530	3,620	
3	.....	.....	.....	.....	2.01	2.00	2.04	4.08	16,300	4,000	.....	
.....	.....	.....	.....	.....	2.00	2.00	1.99	3.98	14,100	3,540	.....	
.....	.....	.....	.....	.....	2.06	1.95	2.02	3.94	11,800	2,990	.....	
.....	.....	.....	.....	.....	2.01	2.03	2.01	4.08	11,200	2,750	.....	
.....	.....	.....	.....	.....	2.06	2.03	2.03	4.12	15,600	3,790	3,410	
4	.....	.....	.....	.....	2.03	2.02	2.01	4.06	16,000	3,940	.....	
.....	.....	.....	.....	.....	2.04	1.91	2.04	3.90	13,200	3,380	.....	
.....	.....	.....	.....	.....	2.00	2.05	2.02	4.14	17,100	4,130	.....	
.....	.....	.....	.....	.....	2.00	1.99	2.02	4.02	17,500	4,350	.....	
.....	.....	.....	.....	.....	2.02	2.02	2.02	4.08	18,200	4,460	4,050	

TESTS OF CUBES SET IN AIR, ETC.—Continued.

Age in—					Dimensions.			Sectional area.	Compressive strength.			Remarks.
Air.			Water.		Height.	Compressed surface.			Total.	Per square inch.	Mean.	
Mos.	*W'ks.*	*Days.*	*Mos.*	*W'ks.*	*Ins.*	*Ins.*	*Ins.*	*Sq. in.*	*Pounds.*	*Pounds*	*Pounds.*	
.....	.....	1	4	.....	2.02	2.06	2.00	4.12	25,400	6,170	.....	
.....	.....	.....	.....	.....	2.00	2.04	2.02	4.12	26,400	6,410	.....	
.....	.....	.....	.....	.....	2.03	2.05	2.03	4.16	25,900	6,230	.....	
.....	.....	.....	.....	.....	2.03	2.04	2.01	4.10	26,400	6,440	.....	
.....	.....	.....	.....	.....	2.01	2.03	2.00	4.06	21,700	5,340	6,120	
.....	1	.....	3	3	2.00	1.98	2.04	4.04	22,800	5,640	.....	
.....	.....	.....	.....	.....	2.02	2.05	2.06	4.22	16,200	3,840	.....	
.....	.....	.....	.....	.....	2.02	2.02	2.04	4.12	19,700	4,780	.....	
.....	.....	.....	.....	.....	2.00	1.99	2.02	4.02	22,000	5,470	.....	
.....	.....	.....	.....	.....	2.02	2.04	2.02	4.12	19,800	4,810	4,910	
.....	2	.....	3	2	2.02	2.03	2.04	4.14	16,800	4,060	.....	
.....	.....	.....	.....	.....	2.02	2.04	2.05	4.18	19,900	4,760	.....	
.....	.....	.....	.....	.....	2.04	2.03	2.00	4.06	17,600	4,330	.....	
.....	.....	.....	.....	.....	2.06	2.03	2.04	4.14	23,600	5,700	.....	
.....	.....	.....	.....	.....	2.02	2.00	1.98	3.96	19,700	4,970	4,760	
.....	3	.....	3	1	2.04	2.01	2.06	4.14	19,900	4,810	.....	
.....	.....	.....	.....	.....	2.07	2.01	2.07	4.16	21,000	5,050	.....	
.....	.....	.....	.....	.....	2.08	2.01	2.04	4.10	19,100	4,660	.....	
.....	.....	.....	.....	.....	2.01	1.99	2.02	4.02	14,600	3,630	.....	
.....	.....	.....	.....	.....	2.00	2.07	2.02	4.18	19,900	4,760	4,580	
.....	3	2	3	1	2.03	2.04	2.04	4.16	18,100	4,350	.....	
.....	.....	.....	.....	.....	2.01	2.04	2.04	4.16	19,500	4,690	.....	
.....	.....	.....	.....	.....	2.05	2.01	2.02	4.06	17,400	4,290	.....	
.....	.....	.....	.....	.....	1.98	2.00	2.05	4.10	20,300	4,950	.....	
.....	.....	.....	.....	.....	2.04	2.03	2.00	4.06	15,900	3,920	4,440	
2	.....	.....	2	.....	2.02	2.06	1.98	4.08	17,400	4,260	.....	
.....	.....	.....	.....	.....	2.02	2.00	2.00	4.00	16,900	4,230	.....	
.....	.....	.....	.....	.....	2.00	1.97	2.02	3.98	19,800	4,970	.....	
.....	.....	.....	.....	.....	2.05	2.03	2.01	4.08	20,700	5,070	.....	
.....	.....	.....	.....	.....	2.01	1.99	2.02	4.02	18,100	4,500	4,610	
3	.....	.....	1	.....	2.04	2.00	2.02	4.04	15,100	3,740	.....	
.....	.....	.....	.....	.....	2.02	2.04	2.06	4.20	17,200	4,100	.....	
.....	.....	.....	.....	.....	1.95	2.05	2.01	4.12	16,100	3,910	.....	
.....	.....	.....	.....	.....	2.05	2.03	2.03	4.12	18,800	4,560	.....	
.....	.....	.....	.....	.....	2.01	2.04	2.02	4.12	16,600	4,030	4,070	
4	.....	.....	.....	.....	3.07	3.00	3.10	9.30	39,400	4,240	.....	
.....	.....	.....	.....	.....	3.00	3.06	3.07	9.39	44,100	4,700	.....	
.....	.....	.....	.....	.....	3.00	3.05	3.09	9.42	41,900	4,450	.....	
.....	.....	.....	.....	.....	3.03	3.00	3.10	9.30	43,300	4,660	4,510	

COMPRESSION TESTS OF CUBES AFTER HAVING BEEN HEATED TO DIFFERENT TEMPERATURES.

The cubes for this series were prepared and set in air or in water for a period of one year to a year and a half before they were heated, and intervals ranging from four days to nearly four months intervened between the time of heating and the time of testing.

The heated cubes were gradually raised to the temperatures recorded, and slowly cooled in dry sawdust or powdered asbestus. The time of heating was one hour, and the maximum temperature was maintained for one hour.

Cubes which were set in water were dried off on a radiator for twenty-four hours before heating in the muffle to the temperatures recorded.

During heating some of the cubes developed fine cracks, at first faintly shown, which enlarged after a few hours or days had elapsed. Photographs are shown illustrating the progressive development of these cracks. In other cases the cracks appeared more promptly. Among those which were heated to the higher temperatures of the series, which ranged from 200° to 1,000° F., there were cubes so badly cracked as to be unsuitable for testing.

TABLE SHOWING LOSS IN WEIGHT OF 4-INCH CUBES UPON HEATING.

Brand of cement.	Composition.			Cubes set in—	Age.			Heated to temperature of—	Weight of cubes.				Loss.		Remarks.
	Cement.	Sand.	Water.						Before heating.		After heating.				
			Per cent.		*Years.*	*Months.*	*Days.*	° *F.*	*Lbs.*	*Ozs.*	*Lbs.*	*Ozs.*	*Ozs.*	*Per ct.*	
Dyckerhoff	Neat.		29.0	Air	1	3	18	600	4	12.5	4	4.5	8.0	10.5	Each of the Dyckerhoff cubes showed slight cracks after heating.
					1	3	18		4	11.0	4	5.0	6.0	8.0	
					1	3	18		4	12.0	4	5.5	6.5	8.6	
Do	Neat.		29.0	Air	1	3	16	700	4	11.0	4	5.0	6.0	8.0	
					1	3	16		4	11.0	4	4.5	6.5	8.1	
					1	3	16		4	8.5	4	3.5	5.0	6.9	
Do	Neat.		29.0	Air	1	3	5	800	4	11.0	4	5.0	6.0	8.0	
					1	3	4		4	11.0	4	5.0	6.0	8.0	
					1	3	4		4	11.0	4	5.0	6.0	8.0	
Do	Neat.		29.0	Air	1	3	2	900	4	10.5	4	3.5	7.0	9.4	
					1	3	2		4	12.5	4	5.0	7.5	9.8	
					1	3	2		4	11.0	4	3.5	7.5	10.0	
Do	Neat.		29.0	Air	1	3	1	1,000	4	11.0	4	3.5	7.5	10.0	
					1	3	1		4	10.0	4	2.5	7.5	10.1	
					1	3	1		4	11.0	4	2.5	8.5	11.3	
Do	Neat.		29.0	Air	1	3	16	1,000	4	12.5	4	4.0	8.5	11.1	
Do	Neat.		29.0	Water	1	3	26	900	5	2.0	4	4.0	14.0	17.1	
					1	3	28		5	2.0	4	4.5	13.5	16.5	
					1	3	28		5	2.0	4	5.0	13.0	15.9	
Do	Neat.		29.0	Water	1	3	23	1,000	5	1.5	4	2.0	15.5	19.0	
					1	3	23		5	2.5	4	4.5	14.0	17.0	
					1	3	23		5	1.0	4	3.0	14.0	17.3	
Steel	Neat.		28.0	Air	1	1	1	200	4	2.5	4	2.0	.5	.8	
									4	2.0	4	1.5	.5	.8	
									4	2.5	4	1.5	1.0	1.5	
Do	Neat.		28.0	Air	1	1	2	300	4	1.5	3	14.0	3.5	5.3	
									4	2.0	3	14.5	3.5	5.3	
									4	2.5	3	15.0	3.5	5.3	

Do	Neat.	28.0	Air	1	1	5	400	4	2.0	3	13.0	5.0	7.6
								4	2.5	3	13.5	5.0	7.5
								4	2.0	3	13.5	4.5	6.8
Do	Neat.	28.0	Air	1	1	22	500	4	1.5	3	12.5	5.0	7.6
								4	1.5	3	13.5	4.0	6.0
								4	0	3	11.5	4.5	7.0
Do	Neat.	28.0	Air	1	1	23	600	4	1.0	3	11.5	5.5	8.5
								4	1.0	3	12.0	5.0	7.7
								4	2.5	3	12.5	6.0	9.0
Do	Neat.	28.0	Air	1	1	24	700	4	2.0	3	11.0	7.0	10.6
								4	2.0	3	11.0	7.0	10.6
								4	2.0	3	11.0	7.0	10.6
Do	Neat.	28.0	Air	1	1	25	800	4	2.0	3	11.5	6.5	9.9
								4	1.0	3	8.5	8.5	13.1
								4	1.5	3	9.5	8.0	12.2
Do	Neat.	28.0	Air	1	1	26	900	4	1.0	3	10.5	6.5	10.0
Do	Neat.	28.0	Water	1	1	28	200	4	8.0	4	8.0	0	0
								4	8.0	4	7.5	.5	.7
								4	8.0	4	7.0	1.0	1.4
Do	Neat.	28.0	Water	1	1	29	300	4	10.0	4	5.0	5.0	6.8
								4	6.5	4	1.0	5.5	7.8
								4	7.0	4	2.0	5.0	7.0
Do	Neat.	28.0	Water	1	2	0	400	4	9.0	4	0	9.0	12.3
								4	8.5	4	0	8.5	11.7
								4	9.0	3	15.0	10.0	13.7
Do	Neat.	28.0	Water	1	2	1	500	4	8.5	4	0.	8.5	11.7
								4	8.5	3	14.5	10.0	13.8
								4	9.0	4	1.0	8.0	11.0
Do	Neat.	28.0	Water	1	2	2	600	4	9.0	3	12.5	12.5	17.1
								4	9.0	3	14.5	10.5	14.4
								4	8.5	3	12.0	12.5	17.2
Do	Neat.	28.0	Water	1	2	3	700	4	8.5	3	10.0	14.5	20.0
								4	7.5	3	10.0	13.5	18.9
								4	8.0	3	11.0	13.0	18.1
Do	Neat.	28.0	Water	1	2	6	800	4	7.0	3	10.0	13.0	18.3
								4	8.0	3	10.0	14.0	19.5
								4	8.0	3	10.0	14.0	19.5
Do	Neat.	28.0	Water	1	2	6	900	4	8.5	3	10.0	14.5	20.0

TABLE SHOWING LOSS IN WEIGHT OF 4-INCH CUBES UPON HEATING—Continued.

Brand of cement.	Composition.			Cubes set in—	Age.			Heated to temperature of—	Weight of cubes.				Loss.		Remarks.
	Cement.	Sand.	Water.						Before heating.		After heating.				
			Per cent.		*Years.*	*Months.*	*Days.*	° *F.*	*Lbs.*	*Ozs.*	*Lbs.*	*Ozs.*	*Ozs.*	*Per ct.*	
Steel	1	1	40.8	Air	1	6	24	200	4	6.0	4	5.5	.5	.7	
									4	6.0	4	5.5	.5	.7	
									4	7.0	4	6.0	1.0	1.4	
Do	1	1	40.8	Air	1	6	25	300	4	6.0	4	5.0	1.0	1.4	
									4	6.0	4	5.0	1.0	1.4	One crack after heating.
									4	5.5	4	4.5	1.0	1.4	
Do	1	1	40.8	Air	1	6	26	400	4	4.0	4	2.5	1.5	2.2	
									4	6.0	4	4.5	1.5	2.1	
									4	7.0	4	5.5	1.5	2.1	
Do	1	1	40.8	Air	1	6	27	600	4	5.0	4	3.0	2.0	2.9	
			38.4		1	6	24		4	5.0	4	3.0	2.0	2.9	Cracked by heat.
			38.4		1	6	24		4	6.0	4	4.0	2.0	2.9	
Do	1	1	38.4	Air	1	6	25	800	4	5.0	4	3.0	2.0	2.9	
									4	6.0	4	3.5	2.5	3.6	Do.
									4	6.0	4	3.5	2.5	3.6	Do.
Do	1	1	38.4	Air	1	6	27	900	4	7.0	4	4.0	3.0	4.2	Do.
									4	5.5	4	3.0	2.5	3.6	Do.
									4	6.0	4	3.0	3.0	4.3	Do.
Do	1	1	38.4	Air	1	6	27	1,000	4	6.5	4	3.0	3.5	5.0	Do.
									4	6.0	4	3.0	3.0	4.3	Do.
Do	1	1	40.8	Water	1	7	3	200	4	13.0	4	12.5	.5	.6	
									4	13.5	4	12.5	1.0	1.3	
									4	12.5	4	12.0	.5	.7	
Do	1	1	40.8	Water	1	7	4	300	4	14.0	4	11.5	2.5	3.2	
									4	12.5	4	8.5	4.0	5.2	
									4	12.0	4	9.0	3.0	4.0	
Do	1	1	40.8	Water	1	7	5	400	4	11.0	4	3.0	8.0	10.7	
									4	12.5	4	5.0	7.5	9.8	
									4	14.5	4	8.0	6.5	10.2	
Do	1	1	40.8	Water	1	7	16	600	4	11.5	4	.5	11.0	14.6	
			38.4		1	7	13		4	14.0	4	3.0	11.0	14.1	
			38.4		1	7	13		4	14.0	4	3.0	11.0	14.1	

Do	1	1	40.8	Water	1	7	17	800	4	13.0	4	1.0	12.0	15.6	
			38.4		1	7	14		4	13.5	4	1.5	12.0	15.5	
			38.4		1	7	14		4	12.5	4	.5	12.0	15.7	
Do	1	1	38.4	Water	1	7	15	1,000	4	13.0	4	.5	12.5	16.2	
									4	13.5	4	.5	13.0	16.8	
									4	14.0	4	1.0	13.0	16.7	
Mankato	Neat.		38.0	Air	1	2	5	200	3	12.0	3	11.5	.5	.8	Each of the neat Mankato cubes set in air showed cracks after heating.
									3	12.0	3	11.5	.5	.8	
									3	12.0	3	10.0	2.0	3.3	
Do	Neat.		38.0	Air	1	2	6	300	3	10.5	3	8.0	2.5	4.3	
									3	11.5	3	8.0	3.5	5.9	
									3	11.0	3	8.0	3.0	5.1	
Do	Neat.		38.0	Air	1	2	7	400	3	12.5	3	8.0	4.5	7.4	
									3	9.5	3	5.5	4.0	7.0	
									3	9.0	3	5.5	3.5	6.1	
Do	Neat.		48.0	Air	1	2	8	500	3	8.0	3	3.0	5.0	8.9	
									3	8.0	3	3.5	4.5	8.0	
									3	9.0	3	5.0	4.0	7.0	
Do	Neat.		48.0	Air	1	2	10	600	3	8.0	3	2.0	6.0	10.7	
									3	8.5	3	3.0	5.5	9.7	
									3	9.5	3	4.0	5.5	9.6	
Do	Neat		48.0	Air	1	2	11	700	3	8.0	3	1.0	7.0	12.5	
									3	8.0	3	2.5	5.5	9.8	
									3	8.5	3	3.0	5.5	9.8	
Do	Neat		48.0	Air	1	2	12	800	3	8.0	3	1.5	6.5	11.6	
									3	8.5	3	1.5	7.0	12.4	
									3	9.5	3	1.0	8.5	14.8	
Do	Neat.		48.0	Air	1	2	13	900	3	10.0	3	.5	9.5	16.4	
									3	8.5	3	0.	8.5	15.0	
Do	Neat.		38.0	Water	1	2	14	200	4	5.5	4	4.5	1.0	1.4	Each of the neat Mankato cubes set in water showed cracks after heating, practically separating the specimens into irregular-shaped pieces when the higher temperatures were employed.
			48.0						4	.5	3	14.5	2.0	3.1	
			48.0						4	.5	3	14.0	2.5	3.9	

TABLE SHOWING LOSS IN WEIGHT OF 4-INCH CUBES UPON HEATING—Continued.

Brand of cement.	Composition.			Cubes set in—	Age.			Heated to temperature of—	Weight of cubes.				Loss.		Remarks.
	Cement.	Sand.	Water.						Before heating.		After heating.				
			Per cent.		*Years.*	*Months.*	*Days.*	°*F.*	*Lbs.*	*Ozs.*	*Lbs.*	*Ozs.*	*Ozs.*	*Per ct.*	
Mankato	Neat.		38.0	Water	1	2	15	300	4	4.0	3	14.5	5.5	8.1	
			48.0						4	2.0	3	10.0	8.0	12.1	
			48.0						4	3.5	3	12.5	7.0	10.4	
Do	Neat.		38.0	Water	1	2	17	400	4	4.0	3	10.5	9.5	14.0	
									4	4.5	3	11.0	9.5	13.9	
									4	4.0	3	11.0	9.0	13.2	
Do	Neat.		38.0	Water	1	2	18	500	4	4.5	3	9.0	11.5	16.8	
			48.0		1	2	18		4	2.5	3	5.0	13.5	20.3	
			48.0		1	2	19		3	15.5	3	3.5	12.0	20.2	
Do	Neat.		48.0	Water	1	2	19	600	4	3.0	3	4.5	14.5	21.6	
					1	2	19		4	2.0	3	3.0	15.0	22.7	
					1	2	20		4	3.0	3	4.0	15.0	22.4	
Do	Neat.		48.0	Water	1	2	20	700	4	3.5	3	3.5	16.0	23.7	
			38.0						4	6.0	3	6.0	16.0	22.9	
			48.0						4	3.0	3	0.	19.0	28.4	
Do	Neat.		48.0	Water	1	2	21	800	4	.5	3	0.	16.5	27.3	
			48.0						4	3.0	3	2.0	17.0	25.4	
			38.0						4	4.0	3	6.0	14.0	20.6	
Do	Neat.		38.0	Water	1	2	24	900	4	4.0	3	4.5	15.5	22.8	
			48.0						4	3.0	3	2.0	17.0	25.4	
Do	1	1	28.0	Air	1	5	29	200	3	15.5	3	15.0	.5	.8	The Mankato 1:1 cubes set in air had slight surface cracks before heating. No new cracks developed upon heating.
			31.0		1	6	0		3	14.0	3	14.0	0.	0.	
			31.0		1	6	1		3	13.5	3	13.5	0.	0.	
Do	1	1	31.0	Air	1	6	1	300	3	13.5	3	12.5	1.0	1.6	
									3	13.0	3	12.5	.5	.8	
									3	14.0	3	13.0	1.0	1.6	
Do	1	1	28.0	Air	1	6	1	500	3	15.0	3	14.0	1.0	1.6	
					1	6	1		3	15.0	3	13.5	1.5	2.4	
					1	6	3		3	15.0	3	13.5	1.5	2.4	

Do	1	1	28.0	Air	1	6	3	700	3	14.5	3	12.5	2.0	3.2	
					1	6	3		4	0.	3	14.0	2.0	3.1	
					1	6	5		3	14.0	3	12.5	1.5	2.4	
Do	1	1	31.0	Air	1	6	6	900	3	13.5	3	10.0	3.5	5.7	
					1	6	7		3	13.0	3	10.0	3.0	4.9	
					1	6	7		3	12.5	3	10.0	2.5	4.1	
Do	1	1	31.0	Air	1	6	8	1,000	3	13.5	3	9.5	4.0	6.5	
			31.0		1	6	8		3	13.5	3	9.5	4.0	6.5	
			28.0		1	6	7		3	15.5	3	12.0	3.5	5.5	
Do	1	1	31.0	Water	1	6	9	200	4	7.5	4	6.5	1.0	1.4	No cracks visible after heating.
									4	8.5	4	6.5	2.0	2.8	
									4	8.5	4	7.5	1.0	1.4	
Do	1	1	31.0	Water	1	6	10	300	4	8.0	4	3.5	4.5	6.3	Do.
			31.0		1	6	10		4	10.0	4	6.0	4.0	5.4	
			28.0		1	6	9		4	7.5	4	5.0	2.5	3.5	
Do	1	1	31.0	Water	1	6	14	500	4	8.0	3	14.5	9.5	13.2	Cracked by heat.
			28.0		1	6	13		4	8.5	3	14.5	10.0	13.8	
			28.0		1	6	13		4	8.0	3	14.5	9.5	13.2	
Do	1	1	28.0	Water	1	6	14	700	4	9.0	3	12.0	13.0	17.8	Do.
									4	9.0	3	12.5	12.5	17.1	
									4	9.0	3	13.0	12.0	16.5	
Do	1	1	31.0	Water	1	6	16	900	4	9.0	3	10.0	15.0	20.6	Do.
			28.0		1	6	15		4	9.0	3	10.5	14.5	19.9	
			28.0		1	6	15		4	9.0	3	10.5	14.6	19.9	
Do	1	1	28.0	Water	1	6	16	1,000	4	9.5	3	10.5	15.0	20.2	Do.
									4	10.0	3	11.0	15.0	20.1	
									4	11.0	3	11.5	15.5	20.7	

No. 1477.

Marks, Pen. June 17.
Composition: Peninsular cement, neat.
Water used in gauging, 22.2 per cent of cement.
Age, set in air, 2 months 13 days.
Weight per cubic foot, 135.3 pounds.
Dimensions, 24″.17 × 3″.90 × 6″.03.
Sectional area, 23.52 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,352	100	0.	0.	Initial load.
7,056	300	.0011	0.	
11,760	500	.0022	0.	
14,112	600	.0029	0.	
18,816	800	.0043	.0001	
23,520	1,000	.0055	.0001	
28,224	1,200	.0069	.0002	
32,928	1,400	.0080	.0003	
37,632	1,600	.0091	.0004	Rested 3¼ hours under initial load.
42,336	1,800	.0100	.0004	
47,040	2,000	.0111	.0005	E (500–2,000) = 3,571,000 pounds per square inch.
51,744	2,200	.0125	.....	
56,448	2,400	.0138	.....	
61,152	2,600	.0150	.....	
65,856	2,800	.0162	.....	
70,560	3,000	.0174	.0010	E (2,000–3,000) = 3,448,000 pounds per square inch.
75,264	3,200	.0186	.0011	
79,968	3,400	.0200	.0012	
84,672	3,600	.0213	.0014	Crack near end.
.....	600	.0085	.....	
.....	1,000	.0059	.....	
.....	1,600	.0093	.....	
.....	2,000	.0118	.....	
.....	2,600	.0155	.....	
.....	3,000	.0178	.....	
.....	2,600	.0158	.....	
.....	2,000	.0120	.....	
.....	1,600	.0099	.....	
.....	1,000	.0064	.....	
.....	600	.0040	.0015	
70,560	3,000	.0179	.....	
84,672	3,600	.0216	.....	
89,376	3,800	.0231	.....	
94,080	4,000	.0248	.0020	E (3,000–4,000) = 3,125,000 pounds per square inch.
98,784	4,200	.0261	.0022	
103,488	4,400	.0279	.0024	
108,192	4,600	.0290	.0026	
112,896	4,800	.0305	.0028	
117,600	5,000	.0324	.0030	
.....	600	.0050	.....	
.....	1,000	.0071	.....	
.....	1,600	.0107	.....	
.....	2,000	.0132	.....	
.....	2,600	.0169	.....	
.....	3,000	.0194	.....	
.....	2,600	.0174	.....	
.....	2,000	.0138	.....	
.....	1,600	.0113	.....	
.....	1,000	.0077	.....	
.....	600	.0051	.0030	
.....	1,000	.0071	.....	
.....	2,000	.0131	.....	
.....	3,000	.0193	.....	
.....	4,000	.0256	.....	
.....	3,000	.0199	.....	
.....	2,000	.0140	.....	
.....	1,000	.0078	.0031	
122,304	5,200	.0345	.0035	
157,800	6,710	.....	.....	Ultimate strength.

The following cubes were set in water before heating:

A 12	Neat.		24.0	1	1	19			Not heated	4.11	4.06	3.94	16.00	215,000	215,800	13,490	
A 13	Neat.			1	1	18			do	4.05	4.09	3.90	15.95	204,000	207,000	12,980	
Do	Neat.			1	1	18			do	4.07	4.10	3.98	16.32	162,000	179,100	10,970	
A 12	Neat.		24.0	1		26		23	200° F.	4.02	4.08	3.97	16.20	257,000	259,000	15,990	
Do	Neat.			1		26		23	do	4.08	4.02	3.94	15.84	225,000	242,000	15,280	
A 13	Neat.			1		25		23	do	4.05	4.08	3.92	15.99	171,000	193,000	12,070	
A 12	Neat.		24.0	1		28		21	300° F.	4.01	4.06	3.98	16.16	220,000	220,000	13,610	
Do	Neat.			1		27		22	do	4.05	4.04	4.00	16.16	228,000	232,500	14,390	
A 13	Neat.			1		26		22	do	4.02	4.11	3.95	16.23	220,000	220,000	13,560	Sustained load ½ minute, then fractured.
A 12	Neat.		24.0	1		28		21	400° F.	4.07	4.06	3.88	15.75	233,000	239,500	15,210	
Do	Neat.			1		28		21	do	4.10	4.05	3.97	16.08	160,000	211,600	13,160	
A 13	Neat.			1		27		21	do	4.06	4.02	4.03	16.20	209,500	209,500	12,930	
A 12	Neat.		24.0	1		29		20	500° F.	4.08	4.08	3.95	16.12	213,000	245,000	15,200	
Do	Neat.			1		29		20	do	4.04	4.03	3.99	16.08	201,000	211,200	13,130	
A 13	Neat.			1		28		20	do	4.05	4.06	3.95	16.04	215,000	215,000	13,400	Sustained load ½ minute. then fractured.
A 12	Neat.		24.0	1	1			19	600° F.	4.01	4.02	3.99	16.04	158,000	187,000	11,660	
A 13	Neat.			1		29		19	do	4.01	4.00	3.99	15.96	220,100	220,100	13,790	
Do	Neat.			1		29		19	do	4.06	4.03	3.96	15.96	206,000	206,000	12,910	Corner gone.
A 13	Neat.		24.0	1	1			18	700° F.	4.00	4.04	3.97	16.04	185,000	189,000	11,780	
Do	Neat.			1	1			18	do	4.01	4.06	3.94	16.00	174,100	174,100	10,880	
Do	Neat.			1	1			18	do	4.03	4.04	3.92	15.84	233,500	233,500	14,740	
A 12	Neat		24.0	1	1	2		17	800° F.	4.03	4.04	3.97	16.04	159,900	159,900	9,970	
A 13	Neat.			1	1	1		17	do	4.06	3.98	3.94	15.68	156,800	156,800	10,000	

Brand of cement, Dyckerhoff.
Cubes set in air before heating.

Marks.	Composition.			Age.					Treatment, heated to—	Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
	Cement.	Sand.	Water.	Before heating.			After heating.			Height.	Compressed surface.				Total.	Per square inch.	
			Per ct.	*Yrs.*	*Mos.*	*Days.*	*Mos.*	*Days.*		*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
D. 19.....	Neat.	.....	29.0	1	6	29	.....	.....	Not heated ..	4.01	3.98	4.09	16.28	75,000	75,500	4,640	
Do.....	Neat.	.....	29.0	1	6	29	.....	.....	.....do	4.04	3.99	4.01	16.00	86,700	86,700	5,420	
Do.....	Neat.	.....	29.0	1	6	29	.....	.....	.....do	4.06	3.99	4.03	16.08	80,300	80,300	4,990	
D. 20.....	Neat.	.....	29.0	1	3	18	3	10	600° F	3.91	4.04	4.07	16.44	58,000	66,800	4,060	The heated cubes developed cracks which were more numerous and wider as higher temperatures were reached during the period of heating.
Do.....	Neat.	.....	29.0	1	3	18	3	10	.....do	4.07	3.96	4.01	15.88	69,800	69,800	4,400	
Do.....	Neat.	.....	29.0	1	3	18	3	10	.....do	4.10	3.96	4.00	15.84	72,500	72,500	4,580	
Do.....	Neat.	.....	29.0	1	3	16	3	12	700° F	3.91	4.02	4.02	16.16	49,700	49,700	3,080	
Do.....	Neat.	.....	29.0	1	3	16	3	12	.....do	4.07	4.03	3.96	15.96	57,900	57,900	3,630	
Do.....	Neat.	.....	29.0	1	3	16	3	12	.....do	4.05	4.02	3.95	15.88	59,400	59,400	3,740	
D. 19.....	Neat.	.....	29.0	1	3	5	3	24	800° F	4.02	3.96	4.05	16.04	70,100	70,100	4,370	
D. 20.....	Neat.	.....	29.0	1	3	4	3	24	.....do	4.06	3.96	4.01	15.88	59,300	59,300	3,730	
Do.....	Neat.	.....	29.0	1	3	4	3	24	.....do	4.04	3.97	4.03	16.00	64,400	75,800	4,740	

The following cubes set in water before heating:

D. 19.....	Neat.	.....	29.0	1	3	2	3	27	900° F	4.00	3.97	4.09	16.24	62,000	109,900	6,770	Cracked during heating.
Do.....	Neat.	.....	29.0	1	3	2	3	27	.....do	3.96	3.99	4.04	16.12	140,500	140,500	8,720	

One specimen heated to 900° and 3 specimens to 1,000° F. rejected on account of being badly cracked.

Brand of cement, Steel.
Cubes set in air before heating.

Marks.	Composition.			Age.					Treatment, heated to—	Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
	Cement.	Sand.	Water.	Before heating.			After heating.			Height.	Compressed surface.				Total.	Per square inch.	
			P. ct.	*Year.*	*Mos.*	*Days.*	*Mos.*	*Days.*		*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
S. 15.....	Neat.	.....	28.0	1	2	7	.....	.....	Not heated..	4.04	3.97	4.03	16.00	33,100	44,000	2,750	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.08	3.94	4.03	15.88	34,400	42,100	2,650	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.02	3.93	4.01	15.76	25,000	42,800	2,720	
Do.....	Neat.	.....	28.0	1	1	1	1	6	200° F.....	4.04	3.99	4.06	16.20	19,800	42,100	2,600	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.03	4.01	3.97	15.92	20,800	39,600	2,490	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.01	4.06	3.96	16.08	39,000	46,200	2,870	
Do.....	Neat.	.....	28.0	1	1	2	1	5	300° F.....	3.97	4.03	4.01	16.16	52,500	52,500	3,250	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.01	4.00	3.98	15.92	36,800	52,200	3,280	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	3.99	4.04	3.95	15.96	49,100	49,100	3,080	
Do.....	Neat.	.....	28.0	1	1	5	1	2	400° F.....	4.05	4.06	3.97	16.12	25,100	45,900	2,850	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.06	3.93	4.01	15.76	54,600	54,600	3,460	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.01	3.98	4.02	16.00	47,500	56,600	3,540	
Do.....	Neat.	.....	28.0	1	1	22	.....	15	500° F.....	3.96	4.00	3.99	15.96	38,000	48,600	3,050	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.00	3.98	4.05	16.12	46,000	50,700	3,150	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	3.96	4.00	4.02	16.08	34,900	51,000	3,170	
Do.....	Neat.	.....	28.0	1	1	23	.....	15	600° F.....	3.95	4.00	4.03	16.12	60,100	62,400	3,870	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	3.96	4.00	4.00	16.00	67,700	67,700	4,230	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	3.98	3.95	4.05	16.00	37,000	61,200	3,830	
Do.....	Neat.	.....	28.0	1	1	24	.....	14	700° F.....	3.93	4.00	4.00	16.00	35,000	50,500	3,160	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.00	4.00	3.97	15.88	39,300	54,600	3,440	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	3.96	3.99	4.05	16.16	36,500	49,200	3,040	
Do.....	Neat.	.....	28.0	1	1	25	.....	13	800° F.....	3.99	4.00	3.95	15.80	36,600	58,900	3,410	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	3.98	3.92	4.08	15.99	21,000	46,400	2,900	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....do.....	4.02	3.98	3.94	15.68	37,800	49,900	3,180	
Do.....	Neat.	.....	28.0	1	1	26	.....	12	900° F.....	3.98	4.10	3.93	16.11	36,900	48,600	3,020	

No. 1481.

Marks, Pen. June 12.
Composition: Peninsular cement, 1; sand, 2.
Water used in gauging, 48.1 per cent of cement.
Age, set in air, 2 months 21 days.
Weight per cubic foot, 125.4 pounds.
Dimensions, 24″.16×3″.86×6″.09.
Sectional area, 23.51 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,351	100	0.	0.	Initial load.
4,702	200	.0008	0.	
7,053	300	.0017	0.	
9,404	400	.0025	.0002	
11,755	500	.0035	.0004	
14,106	600	.0045	.0005	
18,808	800	.0065	.0007	
23,510	1,000	.0086	.0011	
28,212	1,200	.0110	.0015	
32,914	1,400	.0134	.0020	
37,616	1,600	.0160	.0025	
42,318	1,800	.0191	.0033	
47,020	2,000	.0224	.0041	E(500-2,000)=1,974,000 pounds per square inch.
.....	600	.0068	.....	
.....	1,000	.0128	.....	
.....	1,600	.0185	.....	
.....	1,000	.0187	.....	
.....	600	.0099	.0043	
51,722	2,200	.0261	.0053	Corner cracked.
56,424	2,400	.0338	.0090	
57,000	2,420	.....	.....	Ultimate strength.

Brand of cement, Mankato. Cubes set in air before heating.

Marks.	Composition.			Age.					Treatment, heated to—	Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
	Cement.	Sand.	Water.	Before heating.			After heating.			Height.	Compressed surface.				Total.	Per square inch.	
			Per ct.	*Yrs.*	*Mos.*	*Days.*	*Mos.*	*Days.*		*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
M 16	Neat.		38.0	1	2	19			Not heated	4.00	3.98	4.03	16.04	26,400	26,400	1,650	
									do	3.97	4.00	4.06	16.24	28,000	29,300	1,800	
									do	3.97	4.04	4.01	16.20	20,400	34,900	2,150	
Do	Neat.		38.0	1	2	5		14	200° F	3.95	4.02	4.08	16.40	28,300	28,300	1,730	
									do	4.04	3.98	4.04	16.08	26,400	27,100	1,690	
									do	4.02	3.96	4.06	16.08	24,500	25,000	1,550	
Do	Neat.		38.0	1	2	6		13	300° F	3.95	4.01	4.03	16.16	29,200	29,200	1,810	
									do	3.95	4.00	4.04	16.16	26,100	32,500	2,010	Voids.
									do	4.04	3.97	4.02	15.96	27,100	28,900	1,810	
Do	Neat.		38.0	1	2	7		12	400° F	3.95	4.01	4.03	16.16	34,200	35,300	2,180	
									do	4.09	3.98	4.03	16.04	17,000	28,200	1,760	
									do	3.99	4.04	4.04	16.32	19,500	32,000	1,960	
M 17	Neat.		48.0	1	2	8		11	500° F	3.94	4.00	4.05	16.20	28,600	29,100	1,800	
									do	3.97	4.00	4.04	16.16	16,900	26,100	1,620	
									do	3.98	4.03	4.05	16.32	22,300	22,700	1,390	Split.
Do	Neat.		48.0	1	2	10		9	600° F	4.00	4.00	3.98	15.92	19,200	23,000	1,440	
									do	3.95	4.01	4.08	16.36	15,100	21,200	1,300	Corner in bad order.
									do	4.00	3.98	4.02	16.00	23,600	25,900	1,620	
Do	Neat.		48.0	1	2	11		8	700° F	4.00	3.95	4.03	15.92	21,100	29,000	1,820	
									do	4.00	3.95	4.01	15.84	13,000	20,400	1,290	
									do	3.93	4.00	4.00	16.00	14,000	22,100	1,380	
Do	Neat.		48.0	1	2	12		7	800° F	4.00	3.92	4.02	15.76	16,000	17,000	1,080	Split.
									do	3.92	3.99	4.04	16.12	14,200	27,800	1,720	
Do	Neat.		48.0	1	2	13		6	900° F	3.99	3.92	4.05	15.88	11,000	19,300	1,220	
									do	3.95	3.90	4.04	15.76	7,000	18,200	1,150	

The above cubes developed cracks while heating. The first cracks noted in the tests were new cracks or the extension of the initial ones.

The following cubes set in water before heating:

Marks.	Composition.			Age.					Treatment, heated to—	Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
	Cement.	Sand.	Water.	Before heating.			After heating.			Height.	Compressed surface.				Total.	Per square inch.	
			Per ct.	*Yrs.*	*Mos.*	*Days.*	*Mos.*	*Days.*		*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
M 16	Neat.		38.0	1	4	3	.....	.....	Not heated ..	4.00	4.10	4.08	16.73	62,100	66,700	3,990	
M 17	Neat.		48.0	1	4	3	.....	.....	.....do	4.06	4.00	4.11	16.44	52,000	64,500	3,920	
Do	Neat.		48.0	1	4	3	.....	.....	.....do	4.03	4.00	4.10	16.40	57,300	60,800	3,710	
M 16	Neat.		38.0	1	2	14	1	19	200° F	4.00	4.06	4.09	16.61	63,600	72,400	4,360	
M 17	Neat.		48.0	1	2	14	1	19	.....do	3.99	4.05	4.12	16.69	62,800	64,200	3,850	
Do	Neat.		48.0	1	2	14	1	19	.....do	4.06	4.09	4.00	16.36	63,500	64,200	3,920	
M 16	Neat.		38.0	1	2	15	1	18	300° F	4.00	4.06	4.08	16.56	51,000	56,900	3,440	
M 17	Neat.		48.0	1	2	15	1	18	.....do	4.07	4.00	4.12	16.48	55,500	58,600	3,560	
Do	Neat.		48.0	1	2	15	1	18	.....do	4.01	4.06	4.08	16.56	55,700	59,100	3,570	
M 16	Neat.		38.0	1	2	17	1	16	400° F	4.05	4.00	4.06	16.24	66,100	66,100	4,070	
Do	Neat.		38.0	1	2	17	1	16	.....do	4.00	4.06	4.08	16.56	62,200	62,200	3,760	
Do	Neat.		38.0	1	2	17	1	16	.....do	4.08	4.05	4.10	16.60	57,800	59,700	3,600	
M 16	Neat.		38.0	1	2	18	1	15	500° F	4.00	4.10	4.02	16.48	72,000	72,000	4,370	
M 17	Neat.		48.0	1	2	18	1	15	.....do	4.00	4.10	4.02	16.48	63,800	65,500	3,970	
Do	Neat.		48.0	1	2	19	1	14	.....do	4.07	4.01	4.08	16.36	66,400	66,400	4,060	
Do	Neat.		48.0	1	2	19	1	15	600° F	4.04	4.06	4.01	16.28	67,000	67,200	4,130	
Do	Neat.		48.0	1	2	19	1	15	.....do	4.02	4.07	4.06	16.52	60,800	60,800	3,680	
Do	Neat.		48.0	1	2	20	1	14	.....do	4.09	3.98	4.06	16.16	41,000	68,300	4,230	
M 16	Neat.		38.0	1	2	20	1	14	700° F	4.10	4.00	4.07	16.28	73,000	78,200	4,800	
M 17	Neat.		48.0	1	2	20	1	14	.....do	4.03	4.00	4.10	16.40	63,000	66,000	4,020	
Do	Neat.		48.0	1	2	20	1	14	.....do	3.96	4.05	4.01	16.24	11,000	49,500	3,050	
M 16	Neat.		38.0	1	2	21	1	13	800° F	4.03	4.09	4.00	16.36	41,000	71,100	4,350	
M 17	Neat.		48.0	1	2	21	1	13	.....do	3.99	4.06	4.05	16.44	44,000	61,600	3,750	
Do	Neat.		48.0	1	2	21	1	13	.....do	4.05	3.99	4.06	16.20	58,300	58,300	3,600	
M 16	Neat.		38.0	1	2	24	1	10	900° F	3.99	4.06	4.01	16.28	39,000	65,000	3,990	
M 17	Neat.		48.0	1	2	24	1	10	.....do	3.98	4.01	4.01	16.08	29,000	32,000	1,990	

The above cubes, which set in water, after heating developed cracks practically separating the specimens into irregular shaped pieces. These cracks became wider and more numerous as the temperature to which the samples were heated increased. The first cracks referred to in the tests indicate the development of additional cracks due to the applied stresses.

The following cubes set in air before heating:

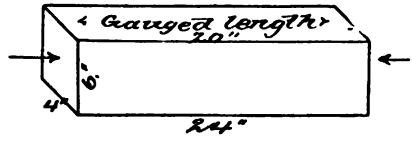
Marks.	Composition.			Age.					Treatment, heated to—	Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
	Cement.	Sand.	Water.	Before heating.			After heating.			Height.	Compressed surface.				Total.	Per square inch.	
			Per ct.	*Yrs.*	*Mos.*	*Days.*	*Mos.*	*Days.*		*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
M. 28	1	1	28.0	1	6	21	.....	.....	Not heated ..	4.04	3.99	4.10	16.36	8,600	8,600	526	
Do	1	1	28.0	1	6	21	.....	.....	.....do	3.98	4.04	4.07	16.44	8,100	8,100	493	
Do	1	1	28.0	1	6	21	.....	.....	.....do	3.98	4.04	4.08	16.48	8,900	8,900	540	
Do	1	1	28.0	1	6	21	.....	.....	.....do	4.02	3.98	4.11	16.36	9,700	9,700	593	This specimen was placed on a wet floor after heating and absorbed some water. It was in a damp state when tested.
M. 27	1	1	31.0	1	6	.....	.....	22	200° F.....	3.96	4.04	4.09	16.52	7,080	7,080	429	
M. 28	1	1	28.0	1	5	29	.....	22	.....do	3.97	4.06	4.11	16.69	.....	7,300	437	
M. 27	1	1	31.0	1	6	1	.....	21	.....do	4.05	3.97	4.06	16.12	9,800	9,800	608	Do.
Do	1	1	31.0	1	6	1	.....	21	300° F.....	4.03	3.97	4.05	16.08	6,670	6,670	415	
Do	1	1	31.0	1	6	1	.....	21	.....do.	4.02	3.95	4.06	16.04	7,240	7,240	451	
Do	1	1	31.0	1	6	1	.....	21	.....do	4.06	3.96	4.10	16.24	7,020	7,020	432	Do.
M. 28	1	1	28.0	1	6	1	.....	20	500° F.....	3.96	4.03	4.12	16.60	6,780	6,730	405	
Do	1	1	28.0	1	6	1	.....	20	.....do	4.01	3.97	4.10	16.28	7,680	7,680	472	
Do	1	1	28.0	1	6	3	.....	18	.....do	3.97	4.04	4.10	16.56	8,900	8,900	537	Do.
Do	1	1	28.0	1	6	3	.....	18	700° F.....	3.96	3.99	4.11	16.40	5,800	5,920	361	
Do	1	1	28.0	1	6	3	.....	18	.....do	3.95	4.03	4.16	16.76	5,780	6,400	382	
Do	1	1	28.0	1	6	5	.....	16	.....do	4.01	3.94	4.11	16.19	6,400	6,480	400	Do.
M. 27	1	1	31.0	1	6	6	.....	16	900° F.....	4.02	3.96	4.02	15.92	3,400	3,800	239	
Do	1	1	31.0	1	6	7	.....	15	.....do	4.02	3.97	4.05	16.08	2,700	4,020	250	
Do	1	1	31.0	1	6	7	.....	15	.....do	3.96	3.99	4.06	16.20	7,200	7,500	463	Do.
Do	1	1	31.0	1	6	8	.....	14	1,000° F.....	3.97	4.01	4.07	16.32	3,100	3,950	242	
Do	1	1	31.0	1	6	8	.....	14	.....do	4.00	3.98	4.09	16.28	4,400	4,600	283	
M. 28	1	1	28.0	1	6	7	.....	14	.....do	3.97	4.04	4.13	16.69	7,100	7,700	461	Do.

The following cubes set in water before heating.

Marks.	Composition.			Age.					Treatment, heated to—	Dimensions.			Sectional area.	First crack.	Compressive strength.		Remarks.
	Cement.	Sand.	Water.	Before heating.			After heating.			Height.	Compressed surface.				Total.	Per square inch.	
			Per ct.	*Yrs.*	*Mos.*	*Days.*	*Mos.*	*Days.*		*Inches.*	*Inches.*	*Inches.*	*Sq. ins.*	*Pounds.*	*Pounds.*	*Pounds.*	
M 27	1	1	31.0	1	6	21	.....	.....	Not heated ..	3.99	4.08	4.00	16.32	39,200	39,200	2,400	
Do	1	1	31.0	1	6	21	.....	.....	.....do	4.04	4.09	4.02	16.44	31,100	34,200	2,080	
Do	1	1	31.0	1	6	21	.....	.....	.....do	3.99	4.08	4.06	16.56	33,100	33,100	2,000	
M 28	1	1	28.0	1	6	20	.....	.....	.....do	4.02	4.10	3.98	16.32	35,700	35,700	2,190	
M 27	1	1	31.0	1	6	9	.....	12	200° F	3.99	4.03	4.09	16.48	35,400	35,400	2,150	
Do	1	1	31.0	1	6	9	.....	12	.....do	4.00	4.05	4.11	16.65	30,200	32,900	1,980	
Do	1	1	31.0	1	6	9	.....	12	.....do	4.00	4.09	4.08	16.69	34,600	34,600	2,070	
M 28	1	1	28.0	1	6	9	.....	11	300° F	4.02	4.03	4.15	16.72	31,000	31,000	1,850	
M 27	1	1	31.0	1	6	10	.....	11	.....do	4.05	4.00	4.09	16.36	32,200	32,200	1,970	
Do	1	1	31.0	1	6	10	.....	11	.....do	4.00	4.01	4.09	16.40	33,400	33,400	2,040	
M 28	1	1	28.0	1	6	13	.....	7	500° F	4.01	4.15	4.01	16.64	37,600	37,600	2,260	
Do	1	1	28.0	1	6	13	.....	7	.....do	4.00	4.01	4.14	16.60	29,200	29,200	1,760	
M 27	1	1	31.0	1	6	14	.....	7	.....do	4.00	4.06	4.10	16.65	36,100	36,100	2,170	
M 28	1	1	28.0	1	6	14	.....	6	700° F	4.03	3.98	4.12	16.40	27,000	27,000	1,650	
Do	1	1	28.0	1	6	14	.....	6	.....do	4.03	3.99	4.13	16.48	34,500	36,300	2,200	
Do	1	1	28.0	1	6	14	.....	6	.....do	4.00	4.04	4.10	16.56	47,500	47,500	2,870	
M 27	1	1	31.0	1	6	16	.....	5	900° F	3.97	4.07	4.09	16.65	21,400	25,200	2,110	Sides flaked off.
M 28	1	1	28.0	1	6	15	.....	5	.....do	3.96	4.01	4.15	16.64	11,000	28,400	1,710	Do.
Do	1	1	28.0	1	6	15	.....	5	.....do	3.96	4.05	4.11	16.65	24,100	24,600	1,480	Do.
Do	1	1	28.0	1	6	16	.....	4	1,000° F	4.05	3.96	4.10	16.24	10,000	25,200	1,550	Do.
Do	1	1	28.0	1	6	16	.....	4	.....do	4.08	3.98	4.11	16.36	16,000	30,100	1,840	Do.
Do	1	1	28.0	1	6	16	.....	4	.....do	4.03	4.00	4.12	16.48	13,000	27,100	1,640	Do.

CEMENT AND MORTAR PRISMS—COMPRESSIVE ELASTIC PROPERTIES.

CEMENT AND MORTAR PRISMS.



No. 1468.

Marks, Alp. March 8.
Composition: Alpha cement, neat.
Water used in gauging, 21.9 per cent of cement.
Age, set in air, 1 month.
Weight per cubic foot, 135.5 pounds.
Dimensions, 23".94×3".84×6".
Sectional area, 23.04 square inches.
Gauged length, 20".
The cement was lumpy in the barrel.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,304	100	0.	0.	Initial load.
4,608	200	.0008	.0001	
6,912	300	.0014	.0001	
9,216	400	.0020	.0001	
11,520	500	.0028	.0001	
13,824	600	.0034	.0001	
16,128	700	.0042	.0001	
18,432	800	.0048	.0001	
20,736	900	.0055	.0001	
23,040	1,000	.0061	0.	
27,648	1,200	.0075	—.0001	
32,256	1,400	.0089	0.	
36,864	1,600	.0101	0.	
41,472	1,800	.0115	.0002	
46,080	2,000	.0131	.0004	E (500–2,000)=3,000,000 pounds per square inch.
50,688	2,200	.0146	.0006	
55,296	2,400	.0161	.0008	
59,904	2,600	.0177	.0010	
64,512	2,800	.0192	.0014	
69,120	3,000	.0208	.0016	E (500–3,000)=3,030,000 pounds per square inch.

Test discontinued.

No. 1468*a*.

Test resumed after an interval of 6 months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,304	100	0.	0.	Micrometer reset at zero.
11,520	500	.0028	.0001	
23,040	1,000	.0060	.0004	
36,864	1,600	.0097	.0006	
46,080	2,000	.0121	.0008	E (500–2,000)=3,488,000 pounds per square inch.
59,904	2,600	.0158	.0010	
69,120	3,000	.0181	.0010	
82,944	3,600	.0224	.0013	
92,160	4,000	.0250	.0015	E (2,000–4,000)=3,279,000 pounds per square inch.
105,984	4,600	.0288	.0019	
115,200	5,000	.0325	.0026	
129,024	5,600	.0370	.0031	Cracked along edge.
138,240	6,000	.0406	.0036	E (4,000–6,000)=2,963,000 pounds per square inch.
152,064	6,600	.0463	.0045	
196,500	8,530	.....	.....	Ultimate strength.

No. 1474.

Marks, Alp. April 26.
Composition: Alpha cement, neat.
Water used in gauging, 21.9 per cent of cement.
Age, set in water, 1 month. (First 2 days in air.)
Weight per cubic foot (immediately after being taken from the water), 137.3 pounds.
Dimensions, 24″.05×3″.85×6″.08.
Sectional area, 23.4 square inches.
Gauged length, 20″.
The cement was lumpy in the barrel. Prism had a crack along one edge when taken from the mold.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,340	100	0.	0.	Initial load.
4,680	200	.0001	0.	
7,020	300	.0003	0.	
9,360	400	.0006	0.	
11,700	500	.0011	0.	
14,040	600	.0016	0.	
16,380	700	.0023	.0001	
18,720	800	.0030	.0001	
21,060	900	.0035	.0002	
23,400	1,000	.0046	.0004	
28,080	1,200	.0064	.0006	
32,760	1,400	.0078	.0009	
37,440	1,600	.0095	.0011	
42,120	1,800	.0109	.0012	
46,800	2,000	.0121	.0012	E (500–2,000)=3,061,000 pounds per square inch.
51,480	2,200	.0136	.0014	
56,160	2,400	.0149	.0015	
60,840	2,600	.0164	.0016	
65,520	2,800	.0179	.0018	

No. 1474—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
70,200	3,000	.0192	.0019	
	200	.0025		
	600	.0051		
	1,000	.0075		
	1,400	.0101		
	1,800	.0125		
	2,200	.0149		
	2,600	.0172		
	2,200	.0152		
	1,800	.0131		
	1,400	.0109		
	1,000	.0085		
	600	.0059		
	200	.0031	.0019	
	200	.0024		
	600	.0051		
	1,000	.0077		
	1,400	.0102		
	1,800	.0126		
	2,200	.0150		
	2,600	.0173		
	2,200	.0153		
	1,800	.0132		
	1,400	.0110		
	1,000	.0086		
	600	.0061		
	200	.0030	.0018	Prism returned to water bath.

Test discontinued.

No. 1474*a*.

Test resumed after an interval of 4 months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,340	100	0.	0.	Micrometer reset at zero.
11,700	500	.0016	0.	
23,400	1,000	.0038	0.	
37,440	1,600	.0064	0.	
46,800	2,000	.0082	0.	E (500–2,000) = 4,545,000 pounds per square inch.
60,840	2,600	.0109	0.	
70,200	3,000	.0128	0.	
84,240	3,600	.0156	.0001	
93,600	4,000	.0177	.0001	E (2,000–4,000) = 4,255,000 pounds per square inch.
107,640	4,600	.0205	.0002	
117,000	5,000	.0226	.0003	
131,040	5,600	.0263	.0006	Cracked along edge.
140,400	6,000	.0288	.0008	E (4,000–6,000) = 3,846,000 pounds per square inch.
216,700	9,260	.....	.....	Ultimate strength.

No. 1471.

Marks, Atl. March 13.
Composition: Atlas cement, neat.
Water used in gauging, 21.9 per cent of cement.
Age, set in air, 2 months 16 days.
Weight per cubic foot, 134.7 pounds.
Dimensions, 23″.98 × 3″.87 × 6″.02.
Sectional area, 23.3 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,330	100	0.	0.	Initial load.
4,660	200	.0013	.0002	
6,990	300	.0026	.0003	
9,320	400	.0039	.0005	
11,650	500	.0051	.0006	
13,980	600	.0062	.0007	
16,310	700	.0075	.0008	
18,640	800	.0086	.0009	
20,970	900	.0097	.0010	
23,300	1,000	.0105	.0012	
27,960	1,200	.0125	.0012	
32,620	1,400	.0142	.0013	
37,280	1,600	.0160	.0014	
41,940	1,800	.0177	.0016	
46,600	2,000	.0193	.0019	E (500–2,000) = 2,326,000 pounds per square inch.
51,260	2,200	.0210	.0024	
55,920	2,400	.0230	.0027	
60,580	2,600	.0248	.0032	
65,240	2,800	.0270	.0039	
69,900	3,000	.0291	.0045	
.....	.....	.....	.0033	After resting 1 hour.
.....	3,000	.0287	.0042	
.....	200	.0050	.....	
.....	400	.0075	.....	
.....	600	.0093	.....	
.....	800	.0114	.....	
.....	1,000	.0134	.....	
.....	1,200	.0153	.....	
.....	1,400	.0169	.....	
.....	1,600	.0186	.....	
.....	1,800	.0201	.....	
.....	2,000	.0217	.....	
.....	2,200	.0233	.....	
.....	2,400	.0250	.....	
.....	2,200	.0238	.....	
.....	2,000	.0225	.....	
.....	1,800	.0211	.....	
.....	1,600	.0198	.....	
.....	1,400	.0183	.....	
.....	1,200	.0168	.....	
.....	1,000	.0151	.....	
.....	800	.0133	.....	
.....	600	.0112	.....	
.....	400	.0091	.....	
.....	200	.0066	.0050	
.....	.....	.....	.0045	After resting 5 minutes.

Test discontinued.

No. 1471*a*.

Test resumed after an interval of 4 months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,330	100	0.	0.	Micrometer reset at zero.
11,650	500	.0044	.0001	
23,300	1,000	.0093	.0005	
37,280	1,600	.0143	.0009	
46,600	2,000	.0175	.0011	E (500–2,000) = 2,479,000 pounds per square inch.
60,580	2,600	.0225	.0016	
69,900	3,000	.0259	.0020	
83,880	3,600	.0315	.0031	
93,200	4,000	.0359	.0040	E (2,000–4,000) = 2,581,000 pounds per square inch.
107,180	4,600	.0423	.0052	
116,500	5,000	.0483	.0074	
127,000	5,450	.....	.....	Ultimate strength.

No. 1499.

Marks, L. July 14.
Composition: Lehigh cement, neat.
Water used in gauging, 27 per cent of cement.
Age, set in air, 1 month 26 days.
Weight per cubic foot, 129.2 pounds.
Dimensions, 24″.03 × 3″.90 × 6″.03.
Sectional area, 23.52 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,352	100	0.	0.	Initial load.
4,704	200	.0011	0.	
7,056	300	.0024	.0002	
9,408	400	.0035	.0004	
11,760	500	.0046	.0005	
14,112	600	.0060	.0006	
16,464	700	.0069	.0008	
18,816	800	.0080	.0009	
21,168	900	.0090	.0009	
23,520	1,000	.0100	.0011	
.....	200	.0022	.....	
.....	400	.0045	.....	
.....	600	.0067	.....	
.....	800	.0085	.....	
.....	600	.0068	.....	
.....	400	.0048	.....	
.....	200	.0025	.0013	
28,224	1,200	.0119	.0013	
32,928	1,400	.0135	.0016	
37,632	1,600	.0151	.0019	
42,336	1,800	.0168	.0022	
47,040	2,000	.0186	.0025	E (500–2,000) = 2,500,000 pounds per square inch.
.....	200	.0035	.....	
.....	400	.0057	.....	
.....	600	.0078	.....	
.....	800	.0095	.....	
.....	600	.0080	.....	
.....	400	.0060	.....	
.....	200	.0036	.0025	

No. 1499—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
51,744	2,200	.0204	.0027	
56,448	2,400	.0222	.0032	
61,152	2,600	.0246	.0037	
65,856	2,800	.0262	.0040	
70,560	3,000	.0283	.0044	
.....	200	.0054	.....	
.....	400	.0075	.....	
.....	600	.0095	.....	
.....	800	.0113	.....	
.....	600	.0097	.....	
.....	400	.0078	.....	
.....	200	.0055	.0041	
.....	200	.0051	.....	
.....	400	.0073	.....	
.....	800	.0112	.....	
.....	1,200	.0144	.....	
.....	1,600	.0174	.....	
.....	2,000	.0205	.....	
.....	1,600	.0178	.....	
.....	1,200	.0150	.....	
.....	800	.0120	.....	
.....	400	.0080	.....	
.....	200	.0057	.0044	
75,264	3,200	.0305	.0049	Crack at corner.
79,968	3,400	.0329	.0055	
84,672	3,600	.0352	.0059	
89,376	3,800	.0377	.0066	
94,080	4,000	.0408	.0072	E (2,000–4,000)=2,353,000 pounds per square inch.
.....	.....	.....	.0065	After 5 minutes.
.....	200	.0076	.....	
.....	400	.0100	.....	
.....	600	.0120	.....	
.....	800	.0139	.....	
.....	600	.0122	.....	
.....	400	.0102	.....	
.....	200	.0079	.0066	
136,300	5,800	.....	.....	Ultimate strength.

No. 1500.

Marks, L. July 15.
Composition: Lehigh cement, 1; sand, 1.
Water used in gauging, 34 per cent of cement
Age, set in air, 1 month 26 days.
Weight per cubic foot, 133 pounds.
Dimensions, 24″.00×3″.91×6.″.06
Sectional area, 23.69 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,369	100	0.	0.	Initial load.
4,738	200	.0006	0.	
7,107	300	.0011	0.	
9,476	400	.0018	0.	
11,845	500	.0025	0.	
14,214	600	.0031	0.	
16,583	700	.0039	.0001	
18,952	800	.0046	.0003	
21,321	900	.0054	.0004	
23,690	1,000	.0063	.0005	
28,428	1,200	.0079	.0007	
33,166	1,400	.0098	.0010	
37,904	1,600	.0116	.0013	
42,642	1,800	.0135	.0018	
47,380	2,000	.0155	.0022	E (500–2,000) =2,778,000 pounds per square inch.
52,118	2,200	.0179	.0027	
56,856	2,400	.0207	.0035	
61,594	2,600	.0231	.0044	
66,332	2,800	.0265	.0054	
71,070	3,000	.0302	.0065	
75,808	3,200	.0345	.0089	
80,546	3,400	.0412	.0116	Cracks along edge.
81,000	3,420	.....	.....	Ultimate strength.

No. 1501

Marks, L. July 16.
Composition: Lehigh cement, neat.
Water used in gauging, 25 per cent of cement.
Age, set in water, 1 month, 26 days.
Weight per cubic foot, 135.9 pounds.
Dimensions, 24″.13×3″.93×6″.06.
Sectional area, 23.82 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,382	100	0.	0.	Initial load.
4,764	200	.0003	0.	
7,146	300	.0006	0.	
9,528	400	.0011	0.	
11,910	500	.0014	0.	
14,292	600	.0019	0.	
16,674	700	.0023	0.	
19,056	800	.0028	0.	
21,438	900	.0031	0.	
23,820	1,000	.0036	0.	
28,584	1,200	.0045	0.	
33,348	1,400	.0054	0.	
38,112	1,600	.0064	0.	
42,876	1,800	.0073	0.	
47,640	2,000	.0083	0.	E(500–2,000) =4,348,000 pounds per square inch.
.....	200	.0003	.....	
.....	400	.0006	.....	
.....	600	.0016	.....	
.....	800	.0025	.....	
.....	1,000	.0035	.....	
.....	1,200	.0045	.....	
.....	1,400	.0055	.....	
.....	1,600	.0064	.....	
.....	1,400	.0054	.....	
.....	1,200	.0045	.....	
.....	1,000	.0035	.....	
.....	800	.0026	.....	
.....	600	.0017	.....	
.....	400	.0008	.....	
.....	200	.0001	0.	
52,404	2,200	.0091	0.	
57,168	2,400	.0100	.0001	
61,932	2,600	.0111	.0001	
66,696	2,800	.0119	.0001	
71,460	3,000	.0129	.0001	E(2,000–3,000) =4,444,000 pounds per square inch.
.....	600	.0013	.....	
.....	1,000	.0031	.....	
.....	1,600	.0059	.....	
.....	2,000	.0079	.....	
.....	2,600	.0109	.....	
.....	2,000	.0080	.....	
.....	1,600	.0060	.....	
.....	1,000	.0031	.....	
.....	600	.0015	.0001	
76,224	3,200	.0139	.0001	
80,988	3,400	.0150	.0002	
85,752	3,600	.0159	.0001	
90,516	3,800	.0169	.0002	
95,280	4,000	.0189	.0003	Fragment detached along edge.
179,600	7,540	.....	.....	Ultimate strength.

No. 1477.

Marks, Pen. June 17.
Composition: Peninsular cement, neat.
Water used in gauging, 22.2 per cent of cement.
Age, set in air, 2 months 13 days.
Weight per cubic foot, 135.3 pounds.
Dimensions, 24″.17 × 3″.90 × 6″.03.
Sectional area, 23.52 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,352	100	0.	0.	Initial load.
7,056	300	.0011	0.	
11,760	500	.0022	0.	
14,112	600	.0029	0.	
18,816	800	.0043	.0001	
23,520	1,000	.0055	.0001	
28,224	1,200	.0069	.0002	
32,928	1,400	.0080	.0003	
37,632	1,600	.0091	.0004	Rested 3¼ hours under initial load.
42,336	1,800	.0100	.0004	
47,040	2,000	.0111	.0005	E (500–2,000) = 3,571,000 pounds per square inch.
51,744	2,200	.0125	.....	
56,448	2,400	.0138	.....	
61,152	2,600	.0150	.....	
65,856	2,800	.0162	.....	
70,560	3,000	.0174	.0010	E (2,000–3,000) = 3,448,000 pounds per square inch.
75,264	3,200	.0186	.0011	
79,968	3,400	.0200	.0012	
84,672	3,600	.0213	.0014	Crack near end.
.....	600	.0035	.....	
.....	1,000	.0059	.....	
.....	1,600	.0093	.....	
.....	2,000	.0118	.....	
.....	2,600	.0155	.....	
.....	3,000	.0178	.....	
.....	2,600	.0158	.....	
.....	2,000	.0120	.....	
.....	1,600	.0099	.....	
.....	1,000	.0064	.....	
.....	600	.0040	.0015	
70,560	3,000	.0179	.....	
84,672	3,600	.0216	.....	
89,376	3,800	.0231	.....	
94,080	4,000	.0248	.0020	E (3,000–4,000) = 3,125,000 pounds per square inch.
98,784	4,200	.0261	.0022	
103,488	4,400	.0279	.0024	
108,192	4,600	.0290	.0026	
112,896	4,800	.0305	.0028	
117,600	5,000	.0324	.0030	
.....	600	.0050	.....	
.....	1,000	.0071	.....	
.....	1,600	.0107	.....	
.....	2,000	.0132	.....	
.....	2,600	.0169	.....	
.....	3,000	.0194	.....	
.....	2,600	.0174	.....	
.....	2,000	.0138	.....	
.....	1,600	.0113	.....	
.....	1,000	.0077	.....	
.....	600	.0051	.0030	
.....	1,000	.0071	.....	
.....	2,000	.0131	.....	
.....	3,000	.0193	.....	
.....	4,000	.0256	.....	
.....	3,000	.0199	.....	
.....	2,000	.0140	.....	
.....	1,000	.0078	.0031	
122,304	5,200	.0345	.0035	
157,800	6,710	.....	.....	Ultimate strength.

No. 1478.

Marks, Pen. June 18.
Composition: Peninsular cement, neat.
Water used in gauging, 27.5 per cent of cement.
Age, set in water, 2 months 14 days.
Weight per cubic foot (as taken from water), 138.0 pounds.
Dimensions, 24″.17×3″.88×6″.04.
Sectional area, 23.43 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,343	100	0.	0.	Initial load.
7,029	300	.0013	.0002	
11,715	500	.0023	.0001	
14,058	600	.0028	.0001	
18,744	800	.0038	.0001	
23,430	1,000	.0048	.0001	
28,116	1,200	.0060	.0001	
32,802	1,400	.0070	.0001	
37,488	1,600	.0081	.0002	
42,174	1,800	.0093	.0004	
46,860	2,000	.0105	.0005	E (500–2,000) = 3,846,000 pounds per square inch.
51,546	2,200	.0116	.0005	
56,232	2,400	.0127	.0005	
60,918	2,600	.0140	.0006	
65,604	2,800	.0153	.0007	
70,290	3,000	.0164	.0008	E (2,000–3,000) = 3,571,000 pounds per square inch.
74,976	3,200	.0175	.0009	
79,662	3,400	.0189	.0010	
84,348	3,600	.0200	.0011	
.....	600	.0040	.....	
.....	1,000	.0062	.....	
.....	1,600	.0094	.....	
.....	2,000	.0115	.....	
.....	2,600	.0149	.....	
.....	3,000	.0171	.....	
.....	2,600	.0150	.....	
.....	2,000	.0120	.....	
.....	1,600	.0099	.....	
.....	1,000	.0068	.....	
.....	600	.0044	.0011	
70,290	3,000	.0169	.....	
84,348	3,600	.0201	.....	
89,034	3,800	.0216	.0018	
93,720	4,000	.0227	.0014	E (3,000–4,000) = 3,509,000 pounds per square inch.
98,406	4,200	.0240	.0015	
103,092	4,400	.0256	.0016	Cracked along lower edge.
107,778	4,600	.0273	.0019	
112,464	4,800	.0289	.0021	Small fragment detached from lower edge.
117,150	5,000	.0306	.0025	
.....	600	.0054	.....	
.....	1,000	.0078	.....	
.....	1,600	.0112	.....	
.....	2,000	.0136	.....	
.....	2,600	.0168	.....	
.....	3,000	.0202	.....	
.....	2,600	.0173	.....	
.....	2,000	.0141	.....	
.....	1,600	.0119	.....	
.....	1,000	.0086	.....	
.....	600	.0060	.0022	
.....	1,000	.0081	.....	
.....	2,000	.0135	.....	
.....	3,000	.0191	.....	
.....	4,000	.0250	.....	
.....	3,000	.0199	.....	
.....	2,000	.0145	.....	
.....	1,000	.0089	.0026	
121,836	5,200	.0321	.0027	
157,500	6,720	.....	.....	Ultimate strength.

No. 1479.

Marks, Pen. June 19.
Composition: Peninsular cement, 1; sand, 1.
Water used in gauging, 32.5 per cent of cement.
Age, set in air, 2 months 13 days.
Weight per cubic foot, 133.4 pounds.
Dimensions, 24″.02×3″.89×6″.02.
Sectional area, 23.42 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,342	100	0.	0.	Initial load.
4,684	200	.0008	0.	
7,026	300	.0014	0.	
9,368	400	.0020	0.	
11,710	500	.0026	0.	
14,052	600	.0032	0.	
18,736	800	.0047	0.	
23,420	1,000	.0063	.0001	
28,104	1,200	.0076	.0002	
32,788	1,400	.0093	.0005	
37,472	1,600	.0108	.0007	
42,156	1,800	.0125	.0010	
46,840	2,000	.0141	.0013	E (500–2,000)=2,941,000 pounds per square inch.
51,524	2,200	.0159	.0013	
56,208	2,400	.0177	.0019	
60,892	2,600	.0200	.0026	
65,576	2,800	.0220	.0029	
70,260	3,000	.0244	.0034	E (2,000–3,000)=2,439,000 pounds per square inch.
74,944	3,200	.0265	.0037	
79,628	3,400	.0290	.0044	
84,312	3,600	.0318	.0051	
.....	600	.0090	.....	
.....	1,000	.0124	.....	
.....	1,600	.0169	.....	
.....	2,000	.0215	.....	
.....	2,600	.0246	.....	
.....	3,000	.0277	.....	
.....	2,600	.0254	.....	
.....	2,000	.0229	.....	
.....	1,600	.0189	.....	
.....	1,000	.0144	.....	
.....	600	.0110	.0057	Micrometer disturbed in its position.
88,996	3,800	.0327	.0044	
93,680	4,000	.0371	.0060	
98,364	4,200	.....	.....	Ultimate strength.

No. 1480.

Marks, Pen. June 20.
Composition: Peninsular cement, 1; sand, 1.
Water used in gauging, 31.8 per cent of cement.
Age, set in water, 2 months 12 days.
Weight per cubic foot (as taken from water), 139.5 pounds.
Dimensions, 24″.16×3″.90×6″.02.
Sectional area, 23.48 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,348	100	0.	0.	Initial load.
4,696	200	.0006	0.	
7,044	300	.0011	0.	
9,392	400	.0018	0.	
11,740	500	.0026	0.	
14,088	600	.0030	.0001	
18,784	800	.0040	.0002	
23,480	1,000	.0050	.0002	
28,176	1,200	.0061	.0004	
32,872	1,400	.0070	.0004	
37,568	1,600	.0081	.0005	
42,264	1,800	.0091	.0005	
46,960	2,000	.0102	.0006	E (500–2,000) = 4,225,000 pounds per square inch.
.....	600	.0082	.....	
.....	1,000	.0054	.....	
.....	1,600	.0084	.....	
.....	1,000	.0057	.....	
.....	600	.0035	.0005	
51,656	2,200	.0115	.0006	
56,352	2,400	.0126	.0008	
61,048	2,600	.0136	.0009	
65,744	2,800	.0149	.0010	
70,440	3,000	.0160	.0011	E (2,000–3,000) = 3,774,000 pounds per square inch.
75,136	3,200	.0173	.0013	
79,832	3,400	.0185	.0014	
84,528	3,600	.0199	.0016	
.....	600	.0043	.....	
.....	1,000	.0066	.....	
.....	1,600	.0096	.....	
.....	2,000	.0118	.....	
.....	2,600	.0148	.....	
.....	3,000	.0170	.....	
.....	2,600	.0151	.....	
.....	2,000	.0126	.....	
.....	1,600	.0106	.....	
.....	1,000	.0075	.....	
.....	600	.0049	.0018	
89,224	3,800	.0215	.0018	
98,920	4,000	.0230	.0021	E (3,000–4,000) = 3,333,000 pounds per square inch.
161,700	6,890	.....	.....	Ultimate strength.

No. 1481.

Marks, Pen. June 12.
Composition: Peninsular cement, 1; sand, 2.
Water used in gauging, 48.1 per cent of cement.
Age, set in air, 2 months 21 days.
Weight per cubic foot, 125.4 pounds.
Dimensions, 24″.16×3″.86×6″.09.
Sectional area, 23.51 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,351	100	0.	0.	Initial load.
4,702	200	.0008	0.	
7,053	300	.0017	0.	
9,404	400	.0025	.0002	
11,755	500	.0035	.0004	
14,106	600	.0045	.0005	
18,808	800	.0065	.0007	
23,510	1,000	.0086	.0011	
28,212	1,200	.0110	.0015	
32,914	1,400	.0134	.0020	
37,616	1,600	.0160	.0025	
42,318	1,800	.0191	.0033	
47,020	2,000	.0224	.0041	E(500-2,000)=1,974,000 pounds per square inch.
.....	600	.0088	.....	
.....	1,000	.0128	.....	
.....	1,600	.0185	.....	
.....	1,000	.0137	.....	
.....	600	.0099	.0043	
51,722	2,200	.0261	.0058	Corner cracked.
56,424	2,400	.0338	.0090	
57,000	2,420	.....	.....	Ultimate strength.

No. 1482.

Marks, Pen. June 21.
Composition: Peninsular cement, 1; sand, 2.
Water used in gauging, 46.4 per cent of cement.
Age, set in water, 2 months 13 days.
Weight per cubic foot, 136.1 pounds.
Dimensions, 24″.17×3″.87×6″.05.
Sectional area, 23.41 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,341	100	0.	0.	Initial load.
4,682	200	.0006	0.	
7,023	300	.0012	0.	
9,364	400	.0016	0.	
11,705	500	.0023	0.	
14,046	600	.0028	0.	
18,728	800	.0041	.0001	
23,410	1,000	.0054	.0001	
28,092	1,200	.0068	.0002	
32,774	1,400	.0078	.0001	
37,456	1,600	.0093	.0003	
42,138	1,800	.0110	.0005	
46,820	2,000	.0128	.0008	E (500–2,000) =3,093,000 pounds per square inch.
.....	600	.0040	.....	
.....	1,000	.0066	.....	
.....	1,600	.0103	.....	
.....	1,000	.0070	.....	
.....	600	.0045	.0009	
51,502	2,200	.0147	.0011	
56,184	2,400	.0167	.0015	
60,866	2,600	.0189	.0019	
65,548	2,800	.0213	.0020	
70,230	3,000	.0239	.0028	E (2,000–3,000) =2,198,000 pounds per square inch.
74,912	3,200	.0269	.0034	
79,594	3,400	.0295	.0040	
.....	600	.0081	.....	
.....	1,000	.0115	.....	
.....	1,600	.0163	.....	
.....	2,000	.0196	.....	
.....	1,600	.0173	.....	
.....	1,000	.0131	.....	
.....	600	.0096	.0043	
91,800	3,920	.....	.....	Ultimate strength.

No. 1483.

Marks, Pen. June 13.
Composition: Peninsular cement, 1; sand, 3.
Water used in gauging, 68 per cent of cement.
Age, set in air, 2 months 20 days.
Weight per cubic foot, 118.8 pounds.
Dimensions, 24.20×3″.83×6″.05.
Sectional area, 23.17 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,317	100	0.	0.	Initial load.
4,634	200	.0014	0.	
6,951	300	.0026	.0001	
9,268	400	.0036	.0001	
11,585	500	.0049	.0002	
13,902	600	.0065	.0005	
16,219	700	.0080	.0007	
18,536	800	.0098	.0011	
20,853	900	.0117	.0015	
23,170	1,000	.0139	.0020	E(500–1,000) =1,389,000 pounds per square inch.
25,487	1,100	.0158	.0024	
27,804	1,200	.0188	.0034	
.....	200	.0045	.....	
.....	400	.0071	.....	
.....	600	.0102	.....	
.....	800	.0131	.....	
.....	1,000	.0160	.....	
.....	800	.0138	.....	
.....	600	.0112	.....	
.....	400	.0082	.....	
.....	200	.0050	.0036	
30,121	1,300	.0217	.0045	
32,438	1,400	.0249	.0056	
34,755	1,500	.0300	.0080	
34,900	1,510	.....	.....	Ultimate strength.

No. 1484.

Marks, Pen. June 23.
Composition: Peninsular cement, 1; sand, 3.
Water used in gauging, 58.3 per cent of cement.
Age, set in water, 2 months 11 days.
Weight, per cubic foot, 130.7 pounds.
Dimensions, 24″.15 × 3″.89 × 6″.05.
Sectional area, 23.53 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,353	100	0.	0.	Initial load.
4,706	200	.0009	.0001	
7,059	300	.0015	.0003	
9,412	400	.0021	.0004	
11,765	500	.0030	.0004	
14,118	600	.0035	.0004	
16,471	700	.0043	.0005	
18,824	800	.0051	.0006	
21,177	900	.0060	.0007	
23,530	1,000	.0070	.0009	E (500–1,000) = 2,857,000 pounds per square inch.
25,883	1,100	.0080	.0009	
28,236	1,200	.0090	.0010	
.....	200	.0017	.....	
.....	400	.0030	.....	
.....	600	.0045	.....	
.....	800	.0062	.....	
.....	1,000	.0075	.....	
.....	800	.0063	.....	
.....	600	.0049	.....	
.....	400	.0035	.....	
.....	200	.0020	.0010	
30,589	1,300	.0101	.0012	
32,942	1,400	.0113	.0014	
35,295	1,500	.0126	.0015	
37,648	1,600	.0140	.0017	
40,001	1,700	.0153	.0020	
42,354	1,800	.0170	.0022	
44,707	1,900	.0189	.0025	
47,060	2,000	.0208	.0029	E (1,000–2,000) = 1,695,000 pounds per square inch.
.....	200	.0036	.....	
.....	400	.0055	.....	
.....	600	.0077	.....	
.....	800	.0095	.....	
.....	1,000	.0118	.....	
.....	1,200	.0137	.....	
.....	1,400	.0157	.....	
.....	1,600	.0176	.....	
.....	1,400	.0163	.....	
.....	1,200	.0149	.....	
.....	1,000	.0133	.....	
.....	800	.0115	.....	
.....	600	.0096	.....	
.....	400	.0078	.....	
.....	200	.0048	.0035	
51,766	2,200	.0260	.0047	
56,472	2,400	.0321	.0068	
60,500	2,570	.....	.....	Ultimate strength.

No. 1485.

Marks: Pen. June 14.
Composition: Peninsular cement, 1; sand, 4.
Water used in gauging, 87 per cent of cement.
Age, set in air, 2 months 21 days.
Weight per cubic foot, 113.4 pounds.
Dimensions, 24″.14 × 3″.85 × 6″.03.
Sectional area, 23.22 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,322	100	0.	0.	Initial load.
4,644	200	.0014	0.	
6,966	300	.0032	.0002	
9,288	400	.0052	.0005	
11,610	500	.0074	.0008	E (100–500) = 1,212,000 pounds per square inch.
13,932	600	.0101	.0015	
16,254	700	.0135	.0025	
18,576	800	.0174	.0036	
20,898	900	.....	.....	Ultimate strength.

No. 1486.

Marks, Pen. June 24.
Composition: Peninsular cement, 1; sand, 4.
Water used in gauging, 80 per cent of cement.
Age, set in water, 2 months 11 days.
Weight per cubic foot, 128.4 pounds.
Dimensions, 24″.15 × 3″.90 × 6″.04.
Sectional area, 23.56 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,356	100	0.	0.	Initial load.
4,712	200	.0011	0.	
7,068	300	.0025	.0003	
9,424	400	.0039	.0005	
11,780	500	.0054	.0006	E (100–500) = 1,667,000 pounds per square inch.
14,136	600	.0072	.0009	
16,492	700	.0097	.0016	
18,848	800	.0125	.0023	
21,204	900	.0163	.0040	
23,560	1,000	.0225	.0065	E (500–1,000) = 893,000 pounds per square inch.
.....	200	.0080	.....	
.....	400	.0119	.....	
.....	600	.0157	.....	
.....	800	.0195	.....	
.....	600	.0170	.....	
.....	400	.0139	.....	
.....	200	.0095	.0067	
24,900	1,060	.....	.....	Ultimate strength.

No. 1466.

Marks, ☆ March 6.
Composition: Star Portland cement, with plaster, neat.
Water used in gauging, 25 per cent of cement.
Age, set in air, 1 month.
Dimensions, 23″.95×3″.89×6″.08.
Sectional area, 23.65 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,365	100	0.	0.	Initial load.
4,730	200	.0007	0.	
7,095	300	.0014	−.0001	
9,460	400	.0021	−.0002	
11,825	500	.0030	−.0002	
14,190	600	.0038	−.0002	
16,555	700	.0046	−.0002	
18,920	800	.0054	−.0002	
21,285	900	.0061	−.0002	
23,650	1,000	.0068	−.0002	
28,380	1,200	.0084	−.0002	
33,110	1,400	.0098	−.0002	
37,840	1,600	.0115	0.	
42,570	1,800	.0130	+.0001	Fine transverse cracks across one 4″ side in three places. Two of these were not visible while the prism was loaded.
47,300	2,000	.0142	.0002	E (500–2,000) = 2,778,000 pounds per square inch.
52,030	2,200	.0159	.0003	
56,760	2,400	.0174	.0005	Longitudinal crack at one end of prism.
61,490	2,600	.0188	.0006	
66,220	2,800	.0205	.0008	
70,950	3,000	.0220	.0010	E (500–3,000) = 2,809,000 pounds per square inch.
75,680	3,200	.0238	.0011	
80,410	3,400	.0255	.0016	
116,100	4,910	.....	.....	Ultimate strength.

An examination of the fragments of the prism after the test showed an effervescence when treated with acid in the vicinity of the transverse cracks previously noted. From this result it is inferred that minute cracks existed in the surface of the prism prior to loading, which penetrated to a depth of $\frac{1}{8}''\pm$.

No. 1467.

Marks, ☆ March 7.
Composition: Star Portland cement, with plaster, neat.
Water used in gauging, 20 per cent of cement.
Age, set in air, 1 month.
Weight per cubic foot, 134 pounds.
Dimensions, 24″.00×3″.89×6″.01.
Sectional area, 23.38 square inches.
Gauged length, 20″.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,338	100	0.	0.	Initial load.
4,676	200	.0007	0.	
7,014	300	.0012	0.	
9,352	400	.0019	−.0001	
11,690	500	.0027	−.0001	
14,028	600	.0036	−.0001	
16,366	700	.0044	0.	
18,704	800	.0051	0.	
21,042	900	.0058	0.	
23,380	1,000	.0067	+ .0001	One transverse crack visible.
28,056	1,200	.0081	.0001	
32,732	1,400	.0097	.0002	
37,408	1,600	.0112	.0004	
42,084	1,800	.0127	.0005	
46,760	2,000	.0141	.0006	E (500–2,000) = 2,804,000 pounds per square inch.

Test discontinued.

No. 1467*a*.

Test resumed after an interval of 5 months.
Ends faced with neat cement at present test. On former occasion the ends were faced with plaster of paris.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,338	100	0.	0.	Micrometer reset at zero.
11,690	500	.0031	0.	
23,380	1,000	.0056	.0001	
37,408	1,600	.0091	.0004	
46,760	2,000	.0118	.0005	E (500–2,000) = 3,659,000 pounds per square inch.
51,436	2,200	.0129	.0005	
56,112	2,400	.0143	.0006	
70,140	3,000	.0183	.0009	
81,830	3,500	.0218	.0012	
93,520	4,000	.0252	.0017	
105,210	4,500	.0289	.0022	
116,900	5,000	.0332	.0028	
93,520	4,000	.....	.....	Load left on prism 19 hours, at the end of which interval there was found a total load of 76,000 pounds = 3,250 pounds per square inch. The loads were then increased until rupture took place.
199,800	8,550	.....	.....	Ultimate strength.

No. 1470.

Marks, ☆ March 12.
Composition: Star Portland cement, without plaster, neat.
Water used in gauging, 28.1 per cent of cement.
Age, set in air, 1 month.
Weight per cubic foot, 126.5 pounds.
Dimensions, 23″.98×3″.87×6″.
Sectional area, 23.22 square inches.
Gauged length, 20″.
A number of oblique cracks were found at corners of prism when mold was stripped.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,322	100	0.	0.	Initial load.
4,644	200	.0013	0.	
6,966	300	.0026	.0001	
9,288	400	.0042	.0001	
11,610	500	.0060	.0004	
13,932	600	.0077	.0006	
16,254	700	.0095	.0009	
18,576	800	.0115	.0013	
20,898	900	.0135	.0017	
23,220	1,000	.0152	.0021	
27,864	1,200	.0191	.0030	9 fine transverse cracks visible.
32,508	1,400	.0230	.0040	
37,152	1,600	.0279	.0056	
41,796	1,800	.0321	.0071	
46,440	2,000	.0370	.0091	E (500–2,000) 1,345,000 pounds per square inch.
51,084	2,200	.0418	.0111	
55,728	2,400	.0470	.0132	
60,372	2,600	.0530	.0168	
.....	400	.0212	.....	
.....	800	.0279	.....	
.....	1,200	.0342	.....	
.....	1,600	.0400	.....	
.....	2,000	.0456	.....	
.....	1,600	.0419	.....	
.....	1,200	.0370	.....	
.....	800	.0314	.....	
.....	400	.0245	.0176	
65,016	3,800	.0596	.0208	
69,660	3,000	.0670	.0246	
.....	.....	.....	.0220	After resting under initial load 1 hour.
.....	400	.0271	.....	
.....	800	.0338	.....	
.....	1,200	.0400	.....	
.....	1,600	.0459	.....	
.....	2,000	.0520	.....	
.....	1,600	.0482	.....	
.....	1,200	.0434	.....	
.....	800	.0379	.....	
.....	400	.0309	.0238	
.....	.....	.....	.0233	After resting 5 minutes.
74,304	3,200	.0738	.0288	
78,948	3,400	.0854	.0367	
.....	.....	.....	.0348	After resting 5 minutes.
.....	.....	.....	.0345	After resting 10 minutes.

No. 1470—Continued.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
.....	400	.0397	.....	
.....	800	.0465	.....	
.....	1,200	.0530	.....	
.....	1,600	.0591	.....	
.....	2,000	.0650	.....	
.....	2,400	.0715	.....	
.....	2,800	.0775	.....	
.....	2,400	.0744	.....	
.....	2,000	.0714	.....	
.....	1,600	.0670	.....	
.....	1,200	.0620	.....	
.....	800	.0560	.....	
.....	400	.0481	.0408	
.....	.....	.....	.0391	After resting 5 minutes.
.....	.....	.....	.0387	After resting 10 minutes.
.....	2,800	.0786	.....	
.....	2,800	.0820	.....	After sustaining load 5 minutes.
.....	2,800	.0830	.....	After sustaining load 10 minutes.
.....	2,800	.0841	.....	After sustaining load 15 minutes.
.....	2,800	.0848	.....	After sustaining load 20 minutes.
.....	2,800	.0854	.....	After sustaining load 25 minutes.
.....	100	.....	.0461	
.....	100	.....	.0439	After resting 5 minutes.
.....	100	.....	.0432	After resting 10 minutes.
.....	2,800	.0837	.....	
.....	2,800	.0859	.....	After sustaining load 5 minutes.
.....	2,800	.0868	.....	After sustaining load 10 minutes.
.....	2,800	.0878	.....	After sustaining load 15 minutes.
.....	2,800	.0882	.....	After sustaining load 20 minutes.
.....	2,800	.0887	.....	After sustaining load 25 minutes.
.....	2,800	.0891	.....	After sustaining load 30 minutes.
.....	2,800	.0896	.....	After sustaining load 35 minutes.
.....	2,800	.0900	.....	After sustaining load 40 minutes.
.....	2,800	.0904	.....	After sustaining load 45 minutes.
.....	2,800	.0909	.....	After sustaining load 50 minutes.
.....	2,800	.0916	.....	After sustaining load 1 hour.
.....	2,800	.0921	.....	After sustaining load 1 hour 10 minutes.
.....	2,800	.0925	.....	After sustaining load 1 hour 20 minutes.
46,440	2,000	.0846	.....	Load left on prism at night.
34,400	1,480	.....	.....	Load found on prism in the morning, 15 hours later.
46,440	2,000	.0893	.....	
65,016	2,800	.0976	.....	
.....	2,800	.0984	.....	After sustaining load 5 minutes.
.....	2,800	.0989	.....	After sustaining load 10 minutes.
.....	2,800	.0994	.....	After sustaining load 20 minutes.
.....	2,800	.0998	.....	After sustaining load 30 minutes.
.....	2,800	.1001	.....	After sustaining load 40 minutes.
.....	2,800	.1006	.....	After sustaining load 50 minutes.
.....	2,800	.1009	.....	After sustaining load 1 hour.
.....	2,800	.1017	.....	After sustaining load 1 hour 30 minutes.
.....	2,800	.1025	.....	After sustaining load 2 hours.
.....	2,800	.1032	.....	After sustaining load 2 hours 30 minutes.
.....	2,800	.1039	.....	After sustaining load 3 hours.
.....	2,800	.1046	.....	After sustaining load 3 hours 30 minutes.
.....	2,800	.1062	.....	After sustaining load 4 hours 50 minutes.

Specimen removed from the machine.
Test resumed after resting without load 21 hours.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,322	100	0.	0.	Initial load. Micrometer reset at zero.
.....	1,000	.0128	.....	There are numerous oblique cracks and one longitudinal crack in prism.
.....	2,000	.0243	.....	
.....	2,800	.0337	.....	
.....	2,800	.0359	.....	After sustaining load 5 minutes.
.....	2,800	.0366	.....	After sustaining load 10 minutes.
.....	2,800	.0375	.....	After sustaining load 20 minutes.
.....	2,800	.0381	.....	After sustaining load 30 minutes.
.....	2,800	.0396	.....	After sustaining load 1 hour.
.....	2,800	.0415	.....	After sustaining load 2 hours.
.....	2,800	.0430	.....	After sustaining load 3 hours.
.....	2,800	.0444	.....	After sustaining load 4 hours.
.....	2,800	.0457	.....	After sustaining load 5 hours.
.....	2,800	.0470	.....	After sustaining load 6 hours.
65,016	2,800	.0472	.....	Load left on prism at night.
63,600	2,740	.0576	.....	Load found on prism in the morning, 15 hours 25 minutes later.
65,016	2,800	.0582	.....	
.....	2,800	.0585	.....	After sustaining load 30 minutes.
.....	2,800	.0589	.....	After sustaining load 1 hour.
.....	2,800	.0594	.....	After sustaining load 2 hours.
.....	2,800	.0600	.....	After sustaining load 3 hours.
.....	2,800	.0604	.....	After sustaining load 4 hours.
.....	2,800	.0605	.....	After sustaining load 4¼ hours.
69,660	3,000	.0623	.....	
74,304	3,200	.0644	.....	
78,948	3,400	.0668	.....	
.....	.....	.0671	.....	After 2 minutes.
.....	100	.....	.0285	
.....	.....	.....	.0273	Do.
.....	3,400	.0671	.....	
.....	.....	.0681	.....	Do.
.....	100	.....	.0280	
.....	.....	.....	.0271	Do.
.....	.....	.....	.0266	After 4 minutes.
94,800	4,080	.....	.....	Ultimate strength.

No. 1469.

Marks, W'H. March 10.
Composition: Whitehall cement, neat.
Water used in gauging, 21.2 per cent of cement.
Age, set in air, 1 month.
Weight per cubic foot, 137 pounds.
Dimensions, 23".99 × 3".88 × 6".01.
Sectional area, 23.32 square inches.
Gauged length, 20".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,332	100	0.	0.	Initial load.
4,664	200	.0006	0.	
6,996	300	.0011	0.	
9,328	400	.0016	0.	
11,660	500	.0021	−.0001	
13,992	600	.0027	−.0001	
16,324	700	.0034	−.0001	
18,656	800	.0038	−.0003	
20,988	900	.0043	−.0003	
23,320	1,000	.0048	−.0003	
27,984	1,200	.0057	−.0004	
32,648	1,400	.0066	−.0005	
37,312	1,600	.0076	−.0005	
41,976	1,800	.0086	−.0005	
46,640	2,000	.0096	−.0005	E (500-2,000) = 3,797,000 pounds per square inch.
51,304	2,200	.0106	−.0004	
55,968	2,400	.0116	−.0004	
60,632	2,600	.0128	−.0003	
65,296	2,800	.0140	−.0002	
69,960	3,000	.0153	0.	

Test discontinued.

No. 1469*a*.

Test resumed after an interval of 6 months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,332	100	0.	0.	Micrometer reset at zero.
11,660	500	.0025	0.	
23,320	1,000	.0055	.0003	
37,312	1,600	.0093	.0007	
46,640	2,000	.0119	.0009	E (500-2,000) = 3,529,000 pounds per square inch.
60,632	2,600	.0157	.0011	
69,960	3,000	.0185	.0013	
83,952	3,600	.0225	.0017	
93,280	4,000	.0255	.0020	E (2,000-4,000) = 3,200,000 pounds per square inch.
107,272	4,600	.0299	.0025	
116,600	5,000	.0331	.0028	
130,592	5,600	.0378	.0035	
139,920	6,000	.0418	.0044	E (4,000-6,000) = 2,878,000 pounds per square inch.
153,912	6,600	.0475	.0055	
163,240	7,000	.0519	.0066	
185,000	7,930	.....	.....	Ultimate strength.

No. 1475.

Marks, W'H. April 30.
Composition: Whitehall cement, neat.
Water used in gauging, 21.2 per cent of cement.
Age, set in water, 1 month. (First day in air.)
Weight per cubic foot (immediately after being taken from the water), 137.5 pounds.
Dimensions, 24".10×3".87×6".09
Sectional area, 23.57 square inches.
Gauged length, 20".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,357	100	0.	0.	Initial load.
4,714	200	.0002	0.	
7,071	300	.0006	−.0001	
9,428	400	.0010	−.0001	
11,785	500	.0015	−.0001	
14,142	600	.0021	−.0001	
16,499	700	.0026	−.0001	
18,856	800	.0031	−.0001	
21,213	900	.0037	−.0001	
23,570	1,000	.0041	−.0001	
28,284	1,200	.0052	−.0001	
32,998	1,400	.0062	−.0002	
37,712	1,600	.0072	−.0002	
42,426	1,800	.0081	−.0002	
47,140	2,000	.0090	−.0002	E (500-2,000)=3,947,000 pounds per square inch.
51,854	2,200	.0097	−.0004	
56,568	2,400	.0106	−.0003	
61,282	2,600	.0115	−.0003	
65,996	2,800	.0124	−.0003	
70,710	3,000	.0134	−.0002	

No. 1475*a*.

Prism rotated one-half turn, was readjusted in the machine and readings repeated as follows:

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,357	100	0.	0.	Initial load.
4,714	200	.0005	−.0001	
7,071	300	.0009	−.0001	
9,428	400	.0014	−.0001	
11,785	500	.0019	−.0001	
14,142	600	.0024	−.0001	
16,499	700	.0030	−.0001	
18,856	800	.0036	−.0001	
21,213	900	.0041	−.0001	
23,570	1,000	.0047	−.0001	
28,284	1,200	.0059	−.0001	
32,998	1,400	.0070	−.0001	
37,712	1,600	.0081	0.	
42,426	1,800	.0092	0.	
47,140	2,000	.0104	+.0001	E (500-2,000)=3,614,000 pounds per square inch.
51,854	2,200	.0116	.0001	
56,568	2,400	.0129	.0002	
61,282	2,600	.0143	.0003	
65,996	2,800	.0155	.0004	
70,710	3,000	.0171	.0006	

Test discontinued. Prism returned to the water bath.

No. 1475*b*.

Test resumed after an interval of 4 months.

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,357	100	0.	0.	Micrometer reset at zero.
11,785	500	.0020	0.	
23,570	1,000	.0044	0.	
37,712	1,600	.0073	0.	
47,140	2,000	.0093	0.	E (500-2,000)=4,110,000 pounds per square inch.
61,282	2,600	.0122	.0001	
70,710	3,000	.0143	.0002	
84,852	3,600	.0172	.0002	
94,280	4,000	.0194	.0004	E (2,000-4,000)=4,124,000 pounds per square inch.
108,422	4,600	.0226	.0006	
117,850	5,000	.0250	.0007	
131,992	5,600	.0283	.0010	
141,420	6,000	.0310	.0012	E (4,000-6,000)=3,704,000 pounds per square inch.
155,562	6,600	.0348	.0014	
164,990	7,000	.0377	.0018	
.....	1,000	.0060	.....	
.....	2,000	.0110	.....	
.....	3,000	.0161	.....	
.....	4,000	.0218	.....	
.....	5,000	.0274	.....	
.....	6,000	.0330	.....	
.....	5,000	.0282	.....	
.....	4,000	.0231	.....	
.....	3,000	.0180	.....	
.....	2,000	.0128	.....	
.....	1,000	.0074	.0026	
216,400	9,180	.....	.....	Ultimate strength.

No. 1454.

Marks, W'H. Sept.18.
Composition: Whitehall cement, neat.
Water used in gauging, 21.3 per cent of cement.
Age, set in air, 21 days.
Weight per cubic foot, 136.1 pounds.
Dimensions, 23".98 × 3".87 × 6".02.
Sectional area, 23.39 square inches.
Gauged length, 20".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,339	100	0.	0.	Initial load.
4,678	200	.0006	0.	
7,017	300	.0012	0.	
9,356	400	.0018	0.	
11,695	500	.0024	.0001	
14,034	600	.0030	.0002	
16,373	700	.0036	.0002	
18,712	800	.0042	.0002	
21,051	900	.0048	.0002	
23,390	1,000	.0054	.0003	
28,068	1,200	.0068	.0003	
32,746	1,400	.0080	.0004	
37,424	1,600	.0092	.0004	
42,102	1,800	.0106	.0005	
46,780	2,000	.0117	.0006	E (500–2,000) = 3,409,000 pounds per square inch.
51,458	2,200	.0131	.0006	
56,136	2,400	.0142	.0007	
60,814	2,600	.0157	.0008	
65,492	2,800	.0172	.0009	
70,170	3,000	.0184	.0011	
74,848	3,200	.0200	.0012	
79,526	3,400	.0214	.0013	
84,204	3,600	.0230	.0016	
88,882	3,800	.0246	.0017	
93,560	4,000	.0262	.0022	E (2,000–4,000) = 3,101,000 pounds per square inch.
98,238	4,200	.0279	.0024	
102,916	4,400	.0298	.0027	
107,594	4,600	.0317	.0032	
112,272	4,800	.0333	.0035	
116,950	5,000	.0353	.0039	
116,950	5,000	.....	.....	Load left on prism at evening.
85,400	3,650	.....	.....	Load found on prism in the morning, 16 hours later.
186,800	7,990	.....	.....	Ultimate strength.

No. 1455.

Marks, W'H. Oct. 6.
Composition: Whitehall cement, neat.
Water used in gauging, 21.3 per cent of cement.
Age, set in air, 7 days.
Weight per cubic foot, 135.3 pounds.
Dimensions, 24".20×3".86×6".05.
Sectional area, 23.35 square inches.
Gauged length, 20".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,335	100	0.	0.	Initial load.
4,670	200	.0006	0.	
7,005	300	.0014	0.	
9,340	400	.0021	0.	
11,675	500	.0027	0.	
14,010	600	.0033	0.	
16,345	700	.0040	0.	
18,680	800	.0046	0.	
21,015	900	.0052	.0001	
23,350	1,000	.0059	.0001	
28,020	1,200	.0072	.0001	
32,690	1,400	.0085	.0001	
37,360	1,600	.0099	.0001	
42,030	1,800	.0112	.0002	
46,700	2,000	.0126	.0003	E (500–2,000) =3,125,000 pounds per square inch.
51,370	2,200	.0143	.0005	
56,040	2,400	.0157	.0006	
60,710	2,600	.0172	.0008	
65,380	2,800	.0186	.0009	
70,050	3,000	.0205	.0013	
74,720	3,200	.0220	.0015	
79,390	3,400	.0239	.0017	
84,060	3,600	.0256	.0020	
88,730	3,800	.0276	.0024	
93,400	4,000	.0300	.0027	E (2,000–4,000) =2,667,000 pounds per square inch.
98,070	4,200	.0326	.0035	Cracks along edge.
102,740	4,400	.0353	.0040	
107,410	4,600	.0382	.0049	
112,080	4,800	.0405	.0058	
116,750	5,000	.0435	.0068	
116,750	5,000	.....	.....	Load left on prism at evening.
89,700	3,840	.....	.....	Load found on prism in the morning, 16 hours later.
139,200	5,960	.....	.....	Ultimate strength. Age when fractured, 8 days.

No. 1456.

Marks, W'H. Oct. 18.
Composition: Whitehall cement, neat.
Water used in gauging, 21.3 per cent of cement.
Age, set in air, 2 days.
Weight per cubic foot, 137 pounds.
Dimensions, 24".11 × 3".84 × 6".04.
Sectional area, 23.19 square inches.
Gauged length, 20".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,319	100	0.	0.	Initial load.
4,638	200	.0005	0.	
6,957	300	.0009	0.	
9,276	400	.0014	0.	
11,595	500	.0020	0.	
13,914	600	.0026	0.	
16,233	700	.0032	0.	
18,552	800	.0039	0.	
20,871	900	.0045	0.	
23,190	1,000	.0051	0.	
27,828	1,200	.0063	.0001	
32,466	1,400	.0076	.....	
				Micrometer disturbed.
51,018	2,200	.0116	− .0005	E (500–2,200) = 3,366,000 pounds per square inch.
55,656	2,400	.0128	− .0004	
60,294	2,600	.0144	− .0001	
64,932	2,800	.0156	0.	
69,570	3,000	.0170	+ .0001	
74,208	3,200	.0184	.0003	
78,846	3,400	.0202	.0006	
83,484	3,600	.0220	.0010	
88,122	3,800	.0238	.0013	
92,760	4,000	.0254	.0015	E (500–4,000) = 3,196,000 pounds per square inch.
97,398	4,200	.0273	.0019	
102,036	4,400	.0296	.0024	
106,674	4,600	.0325	.0035	
111,312	4,800	.0345	.0038	
115,950	5,000	.....	.....	Ultimate strength.

No. 1457.

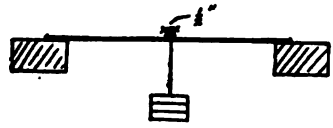
Marks, W'H. Oct. 21.
Composition: Whitehall cement, neat.
Water used in gauging, 21.3 per cent of cement.
Age, set in air, 25 hours.
Weight per cubic foot, 136.7 pounds.
Dimensions, 24".10×3".80×6".05.
Sectional area, 22.99 square inches.
Gauged length, 20".

Applied loads.		In gauged length.		Remarks.
Total.	Per square inch.	Compression.	Set.	
Pounds.	*Pounds.*	*Inch.*	*Inch.*	
2,299	100	0.	0.	Initial load.
4,598	200	.0006	0.	
6,897	300	.0013	.0002	
9,196	400	.0019	.0002	
11,495	500	.0025	.0002	
13,794	600	.0033	.0004	
16,093	700	.0039	.0005	
18,392	800	.0046	.0005	
20,691	900	.0053	.0005	
22,990	1,000	.0059	.0006	
25,289	1,100	.0066	.0006	
27,588	1,200	.0074	.0007	
29,887	1,300	.0080	.0007	
32,186	1,400	.0087	.0008	
34,485	1,500	.0096	.0009	
36,784	1,600	.0102	.0010	
41,382	1,800	.0117	.0011	
45,980	2,000	.0131	.0013	E (500–2,000) =3,158,000 pounds per square inch.
50,578	2,200	.0147	.0015	
55,176	2,400	.0165	.0018	
59,774	2,600	.0181	.0020	
64,372	2,800	.0197	.0023	
68,970	3,000	.0216	.0025	
73,568	3,200	.0236	.0029	
78,166	3,400	.0260	.0034	
82,764	3,600	.0283	.0040	E (500–3,600) =2,818,000 pounds per square inch.
106,400	4,630	.....	.....	Ultimate strength.

GLASS.

TRANSVERSE TESTS.

Lights of common window glass supported at the ends and loaded at the middle.



Length, 2 feet 6 inches.
Depth, .121 inch.
Width, 4.95 inches.
Span, 2 feet.

Total load at middle.	Deflections.	Successive deflections.	Set.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	
1.5	0.	0.	.....	Initial load.
2.0	.0193	.0193	0.	
2.5	.0350	.0157	.....	
3.0	.0534	.0184	.....	
3.5	.0717	.0183	.....	
4.0	.0909	.0192	.....	
4.5	.1099	.0190	.....	
5.0	.1288	.0189	.0003	
5.5	.1480	.0192	.....	
6.0	.1667	.0187	.....	
6.5	.1860	.0193	.....	
7.0	.2047	.0187	.....	
7.5	.2239	.0192	.....	Glass ruptured.

Modulus of rupture, 3,730 pounds per square inch. Modulus of elasticity (between 4 and 7 pounds), 10,300,000 pounds per square inch.

Length, 2 feet 2 inches.
Depth, .119 inch.
Width, 5.02 inches.
Span, 2 feet.

Total load at middle.	Deflections.	Successive deflections.	Sets.	Remarks.
Pounds.	*Inch.*	*Inch.*	*Inch.*	
1.5	0.	0.	.....	Initial load.
2.0	.0135	.0135	.....	
2.5	.0314	.0179	.....	
3.0	.0488	.0174	.....	
3.5	.0671	.0183	.....	
4.0	.0853	.0182	.....	
4.5	.1035	.0182	.....	
5.0	.1217	.0182	.0007	
5.5	.1400	.0183	.....	
6.0	.1583	.0183	.....	
6.0	.1599	.0016	.0011	After 18 hours under 6 pounds load.
6.0	.1595	.....	.....	

Glass ruptured 21 hours after the 6-pound load was applied—3 hours after the last set was taken.

Modulus of rupture, 3,040 pounds per square inch. Modulus of elasticity (between 3 and 6 pounds), 11,190,000 pounds per square inch.

DOUGLAS FIR AND WHITE OAK WOODS.

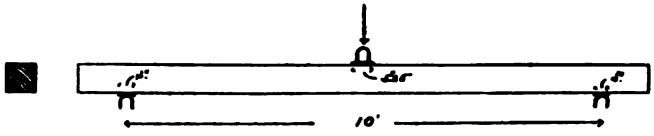
TRANSVERSE AND SHEARING TESTS; ALSO OBSERVATIONS ON HEAT CONDUCTIVITY OF STICKS OVER WOOD FIRES AND A STICK EXPOSED TO LOW TEMPERATURE. EXPANSION CROSSWISE THE GRAIN OF WOOD AFTER SUBMERSION.

Douglas Fir Wood.

DETAILS OF TRANSVERSE TESTS.

No. 717.

Marks, 7. (First specimen.)
Length, 12 feet.
Breadth, 7".59.
Depth, 7".58.
Weight, 155 pounds. Weight per cubic foot, 32.33 pounds.
Rate of growth, 12 rings per inch.



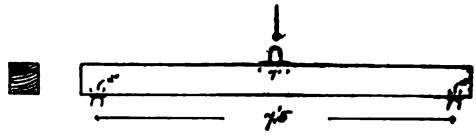
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.087	.087	.....	
2,000	.....	.110	.073	.002	
3,000	.....	.179	.069	.....	
4,000	.....	.252	.073	.008	
5,000	.....	.324	.072	.....	
6,000	.....	.398	.074	.005	
7,000	.....	.468	.070	.....	
8,000	.....	.541	.073	.008	
9,000	.....	.615	.074	.....	
10,000	.....	.687	.072	.011	
11,000	.....	.764	.077	.....	
12,000	.....	.838	.074	.014	E (2,000-12,000)=1,825,000 pounds per square inch.
13,000	.....	.909	.071	.....	
14,000	.....	.984	.075	.017	
15,000	.....	1.059	.075	.....	
16,000	.....	1.142	.083	.....	
17,000	.....	1.222	.080	.....	
27,800	11,470	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side, with crushing of the fibers on the compression side in the vicinity of the middle shoe.

No. 734.

Marks, 7. (Second specimen.)
Length, 8.23 feet.
Breadth, 7″.37.
Depth, 7″.44.
Weight, 112 pounds. Weight per cubic foot, 35.72 pounds.
Rate of growth, 12 rings per inch.



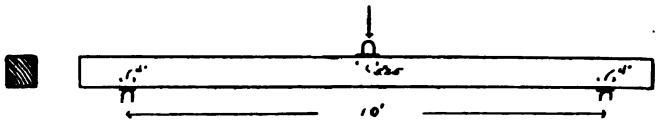
Ends supported 7.5 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.014	.014	.....	
2,000	.....	.047	.033	.002	
3,000	.....	.079	.032	.....	
4,000	.....	.111	.032	.004	
5,000	.....	.143	.032	.....	
6,000	.....	.175	.032	.005	
7,000	.....	.206	.031	.....	
8,000	.....	.238	.032	.008	
9,000	.....	.269	.031	.....	
10,000	.....	.300	.031	.009	
11,000	.....	.332	.032	.....	
12,000	.....	.365	.033	.011	E (2,000–12,000)=1,943,000 pounds per square inch.
13,000	.....	.395	.030	.....	
14,000	.....	.427	.032	.013	
15,000	.....	.463	.036	.....	
16,000	.....	.496	.033	.014	
17,000	.....	.531	.035	.....	
18,000	.....	.563	.032	.017	
19,000	.....	.597	.034	.....	
20,000	.....	.628	.031	.....	
36,600	12,110	.....	.....	.....	Ultimate strength.

Beam fractured on the tension side, followed by shearing along the grain.

No. 718.

Marks, 12.
Length, 12 feet.
Breadth, 7″.57.
Depth, 7″.54.
Weight, 159 pounds. Weight per cubic foot, 33.43 pounds.
Rate of growth, 11 rings per inch.



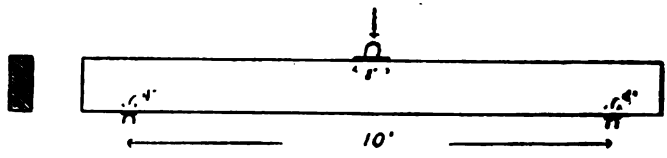
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.040	.040	.....	
2,000	.....	.117	.077	.003	
3,000	.....	.194	.077	.....	
4,000	.....	.270	.076	.006	
5,000	.....	.346	.076	.....	
6,000	.....	.421	.075	.009	
7,000	.....	.498	.077	.....	
8,000	.....	.577	.079	.012	
9,000	.....	.650	.073	.....	
10,000	.....	.726	.076	.016	
11,000	.....	.804	.078	.....	
12,000	.....	.881	.077	.018	E (2,000–12,000)=1,777,000 pounds per square inch.
13,000	.....	.957	.076	.....	
14,000	.....	1.042	.085	.....	
15,000	.....	1.124	.082	.....	
16,000	.....	1.211	.087	.....	
17,000	.....	1.295	.084	.....	
23,900	10,000	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side, with crushing of the fibers on the compression side in the vicinity of the middle shoe.

No. 707.

Marks, 13.
Length, 12 feet.
Breadth, 5″.50.
Depth, 13″.40.
Weight, 211 pounds. Weight per cubic foot, 34.35 pounds.
Rate of growth, 9 rings per inch.



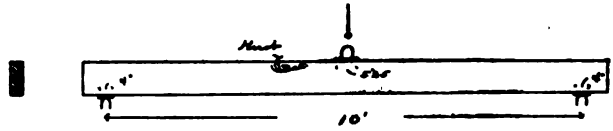
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
1,000	.....	.023	.023	.....	
2,000	.....	.049	.026	.....	
3,000	.....	.075	.026	.....	
4,000	.....	.102	.027	.....	
5,000	.....	.128	.026	.....	
6,000	.....	.154	.026	.....	
7,000	.....	.178	.024	.....	
8,000	.....	.202	.024	.....	
9,000	.....	.226	.024	.....	
10,000	.....	.252	.026	.....	
11,000	.....	.277	.025	.....	E (1,000–11,000)=1,285,000 pounds per square inch.
12,000	.....	.304	.027	.....	
13,000	.....	.331	.027	.....	
14,000	.....	.359	.028	.....	
15,000	.....	.388	.029	.....	
16,000	.....	.411	.023	.....	
17,000	.....	.439	.028	.....	
18,000	.....	.472	.033	.....	
19,000	.....	.509	.037	.....	
20,000	.....	.543	.034	.....	Shoe at middle indented the wood $\frac{1}{4}$″. Shoe 5$\frac{1}{2}$″ wide now used.
21,000	.....	.....	.....	.....	Shoe indented the wood $\frac{1}{2}$″. Shoe 8″ wide now used.
41,000	7,470	.....	.....	.....	Ultimate strength.

The beam fractured on the tension side, 3 feet from middle of length, extending about 6 feet diagonally across the stick. Shoe at middle bearing indented the wood from $\frac{1}{4}$″ to $\frac{5}{8}$″.

No. 720.

Marks, 15. (First specimen.)
Length, 11.07 feet.
Breadth, 2″.80.
Depth, 7″.65.
Weight, 56 pounds. Weight per cubic foot, 33.98 pounds.
Rate of growth, 23 rings per inch.



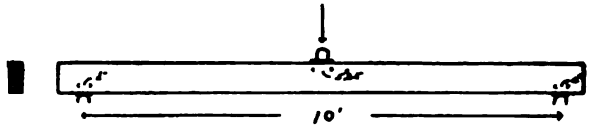
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
400	.....	.088	.088	.....	
600	.....	.075	.037	.....	
800	.....	.111	.036	.....	
1,000	.....	.151	.040	.001	
2,000	.....	.333	.182	.001	
3,000	.....	.513	.180	.002	
4,000	.....	.695	.182	.006	E (1,000–4,000) = 1,918,000 pounds per square inch.
5,000	.....	.871	.176	.010	
6,000	.....	1.061	.190	.....	
6,200	.....	1.100	.039	.....	
6,400	.....	1.137	.037	.....	
6,600	.....	1.183	.046	.....	
6,800	.....	1.227	.044	.....	
7,000	.....	1.277	.050	.....	
10,200	11,200	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side of the beam. Fibers crushed at the middle bearing.

No. 719.

Marks, 15. (Second specimen.)
Length, 11.06 feet.
Breadth, 2″.86.
Depth, 7″.50.
Weight, 56 pounds. Weight per cubic foot, 33.97 pounds.
Rate of growth, 23 rings per inch.



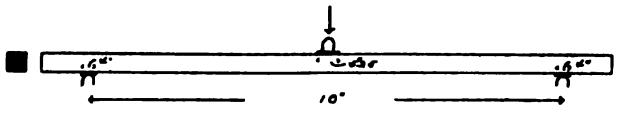
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
400	.....	.089	.089	.....	
600	.....	.078	.089	.....	
800	.....	.116	.088	.....	
1,000	.....	.152	.086	.004	
2,000	.....	.339	.187	.008	
3,000	.....	.582	.198	.013	E (1,000–3,000) = 1,930,000 pounds per square inch.
4,000	.....	.717	.185	.016	
5,000	.....	.907	.190	.021	
6,000	.....	1.118	.211	.....	
6,200	.....	1.160	.042	.....	
6,400	.....	1.206	.046	.....	
6,600	.....	1.256	.050	.....	
6,800	.....	1.309	.053	.....	
7,000	.....	1.368	.059	.....	
7,700	8,610	.....	.....	.....	Ultimate strength.

Split along the grain diagonally from near the middle almost to the end.

No. 712.

Marks, 22. (Tested perpendicular to rings of growth.)
Length, 12.02 feet.
Breadth, 4".53.
Depth, 4".51.
Weight, 61 pounds. Weight per cubic foot, 35.74 pounds.
Rate of growth, 12 rings per inch.



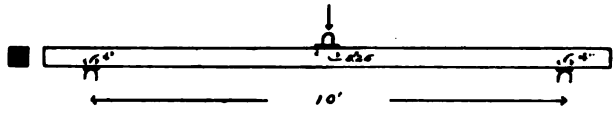
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
400	.....	.086	.086	.....	
500	.....	.135	.049	.....	
1,000	.....	.367	.232	.001	
1,500	.....	.594	.227	.....	
2,000	.....	.827	.233	.010	E (1,000–2,000)=2,305,000 pounds per square inch.
2,500	.....	1.075	.248	.....	
3,000	.....	1.312	.237	.....	
3,500	.....	1.555	.243	.....	
4,000	.....	1.809	.254	.....	
4,900	9,570	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side, taking a diagonal direction a distance of about 3 feet.

No. 713.

No. 22. (Tested parallel to rings of growth.)
Length, 12 feet.
Breadth, 4″.49.
Depth, 4″.50.
Weight, 60 pounds. Weight per cubic foot, 35.63 pounds.
Rate of growth, 12 rings per inch.



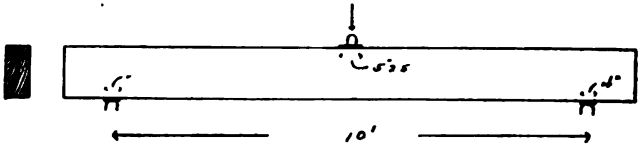
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	.0	0.	.....	Initial load.
400	.....	.091	.091	.....	
500	.....	.137	.046	.....	
1,000	.....	.369	.232	.001	
1,500	.....	.609	.240	.....	
2,000	.....	.855	.246	.011	E (1,000-2,000)=2,218,000 pounds per square inch.
2,500	.....	1.100	.245	.....	
3,000	.....	1.334	.234	.....	
4,500	8,910	.....	.....	.....	Ultimate strength.

Split along the grain diagonally, beginning at middle and extending almost to the end.

No. 708.

Marks, 28.
Length, 11.99 feet.
Breadth, 5″.52.
Depth, 13″.35.
Weight, 207 pounds. Weight per cubic foot, 33.74 pounds.
Rate of growth, 14 rings per inch.



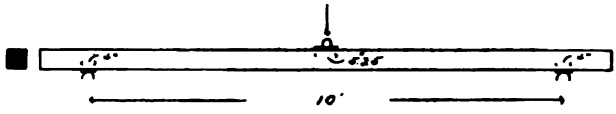
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.014	.014	.....	
2,000	.....	.038	.024	.....	
3,000	.....	.062	.024	.....	
4,000	.....	.085	.023	.....	
5,000	.....	.108	.023	.....	
6,000	.....	.131	.023	.....	
7,000	.....	.154	.023	.....	
8,000	.....	.177	.023	.....	
9,000	.....	.199	.022	.....	
10,000	.....	.221	.022	.....	
11,000	.....	.245	.024	.....	
12,000	.....	.267	.022	.....	E (2,000-12,000)=1,436,000 pounds per square inch.
13,000	.....	.290	.023	.....	
14,000	.....	.312	.022	.....	
15,000	.....	.336	.024	.....	
16,000	.....	.358	.022	.....	
17,000	.....	.381	.023	.....	
18,000	.....	.403	.022	.....	
19,000	.....	.426	.023	.....	
20,000	.....	.449	.023	.....	
21,000	.....	.472	.023	.....	
22,000	.....	.497	.025	.....	
23,000	.....	.520	.023	.....	
24,000	.....	.543	.023	.....	
25,000	.....	.566	.023	.....	
26,000	.....	.596	.029	.....	
27,000	.....	.621	.026	.....	
28,000	.....	.648	.027	.....	
29,000	.....	.673	.025	.....	
30,000	.....	.702	.029	.....	
30,500	.....	.....	.....	.....	Load removed and a shoe 10″ wide put in place at middle bearing.
48,000	8,780	.....	.....	.....	Ultimate strength.

Sheared along the grain in three places. Fibers crushed on the compression side near the middle.

No. 714.

Marks, 31. (Tested perpendicular to rings of growth.)
Length, 12 feet.
Breadth, 4″.90.
Depth, 4″.87.
Weight, 67.5 pounds. Weight per cubic foot, 33.92 pounds.
Rate of growth, 17 rings per inch.



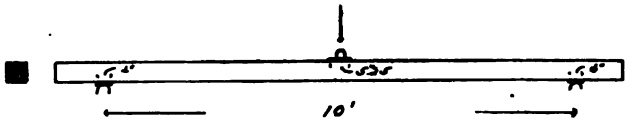
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
500	.....	.120	.120	.....	
1,000	.....	.327	.207	.006	
1,500	.....	.533	.206	.....	
2,000	.....	.746	.213	.018	E (1,000-2,000)=1,875,000 pounds per square inch.
2,500	.....	.956	.210	.....	
3,000	.....	1.169	.213	.....	
3,500	.....	1.381	.212	.....	
5,350	8,290	.....	.....	.....	Ultimate strength.

Split along the grain diagonally, beginning on tension side.

No. 715.

Marks, 31. (Tested parallel to rings of growth.)
Length, 12 feet.
Breadth, 4″.81.
Depth, 4″.86.
Weight, 66 pounds. Weight per cubic foot, 33.89 pounds.
Rate of growth, 17 rings per inch.



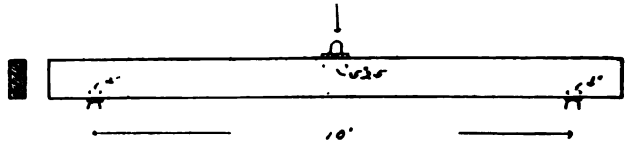
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
500	.....	.123	.123	.....	
1,000	.....	.331	.208	.008	
1,500	.....	.539	.208	.....	
2,000	.....	.750	.211	.012	E (1,000–2,000)=1,885,000 pounds per square inch.
2,500	.....	.958	.208	.....	
3,000	.....	1.177	.219	.....	
3,500	.....	1.392	.215	.....	
5,100	8,080	.....	.....	.....	Ultimate strength.

Split along the grain diagonally from middle to one end.

No. 716.

Marks, 34. (First specimen.)
Length, 12 feet.
Breadth, 3″.80.
Depth, 9″.70.
Weight, 91 pounds. Weight per cubic foot, 29.62 pounds.
Rate of growth, 11 rings per inch.



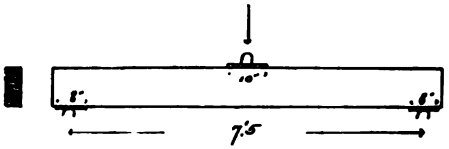
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.057	.057	.....	
1,500	.....	.117	.060	.....	
2,000	.....	.173	.056	.006	
2,500	.....	.229	.056	.....	
3,000	.....	.286	.057	.....	
3,500	.....	.344	.058	.....	
4,000	.....	.403	.059	.011	
4,500	.....	.461	.058	.....	
5,000	.....	.519	.058	.....	
5,500	.....	.577	.058	.....	
6,000	.....	.636	.059	.017	E (2,000–6,000)=1,102,000 pounds per square inch.
6,500	.....	.696	.060	.....	
7,000	.....	.757	.061	.....	
7,500	.....	.822	.065	.....	
8,000	.....	.885	.063	.031	
8,500	.....	.943	.058	.....	
9,000	.....	1.010	.067	.....	
9,500	.....	1.084	.074	.....	
10,000	.....	1.155	.071	.....	
13,800	6,950	.....	.....	.....	Ultimate strength.

Splintering fractures on tension side extending half the depth of the beam. Fibers crushed on the compression side.

No. 736.

Marks, 34. (Second specimen.)
Length, 8.22 feet.
Breadth, 3″.78.
Depth, 9″.70.
Weight, 63 pounds. Weight per cubic foot, 30.08 pounds.
Rate of growth, 11 rings per inch.



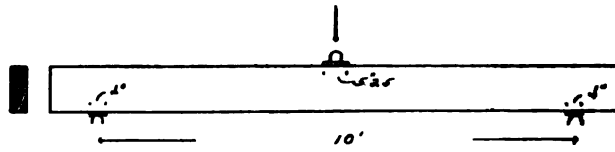
Ends supported 7.5 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
1,000	.....	0.	0.	.....	Initial load.
2,000	.....	.043	.043	.....	
3,000	.....	.086	.043	.....	
4,000	.....	.128	.042	.006	
5,000	.....	.169	.041	.....	
6,000	.....	.213	.044	.....	
7,000	.....	.253	.040	.....	
8,000	.....	.294	.041	.009	
9,000	.....	.337	.043	.....	
10,000	.....	.380	.043	.....	
11,000	.....	.425	.045	.....	
12,000	.....	.471	.046	.018	E (4,000–12,000) = 1,277,000 pounds per square inch.
13,000	.....	.512	.041	.....	
14,000	.....	.557	.045	.....	
23,300	8,840	.....	.....	.....	Ultimate strength.

Beam fractured on the tension side. Fibers crushed at middle bearing.

No. 710.

Marks, 40. (First specimen.)
Length, 12 feet.
Breadth, 3″.70.
Depth, 11″.15.
Weight, 124 pounds. Weight per cubic foot, 36.04 pounds.
Rate of growth, 18 rings per inch.



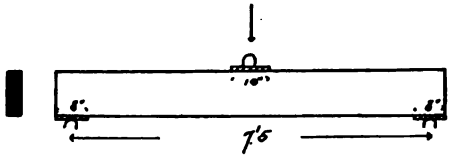
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.027	.027	.....	
2,000	.....	.081	.054	.004	
3,000	.....	.134	.053	.....	
4,000	.....	.186	.052	.008	
5,000	.....	.241	.055	.....	
6,000	.....	.292	.051	.012	
7,000	.....	.350	.058	.....	
8,000	.....	.403	.053	.015	E (2,000–8,000)=1,625,000 pounds per square inch.
9,000	.....	.458	.053	.....	
10,000	.....	.510	.052	.017	
11,000	.....	.562	.052	.....	
12,000	.....	.614	.052	.020	
13,000	.....	.668	.054	.....	
14,000	.....	.721	.053	.024	Rested 1 hour under 500 pounds.
15,000	.....	.769	.048	.....	
16,000	.....	.828	.059	.028	
16,500	6,460	.....	.....	.....	Ultimate strength.

Cross grained, split along the grain diagonally almost from end to end.

No. 735.

Marks, 40. (Second specimen.)
Length, 8.16 feet.
Breadth, 3″.70.
Depth, 11″.13.
Weight, 77 pounds. Weight per cubic foot, 33 pounds.
Rate of growth, 18 rings per inch.



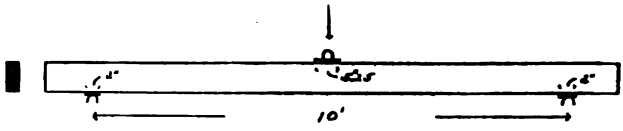
Ends supported 7.5 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
1,000	.....	0.	0.	.....	Initial load.
2,000	.....	.029	.029	.....	
3,000	.....	.057	.028	.....	
4,000	.....	.085	.028	.004	
5,000	.....	.113	.028	.....	
6,000	.....	.140	.027	.....	
7,000	.....	.167	.027	.....	
8,000	.....	.195	.028	.007	
9,000	.....	.223	.028	.....	
10,000	.....	.250	.027	.....	
11,000	.....	.276	.026	.....	
12,000	.....	.304	.028	.010	E (4,000–12,000)=1,842,000 pounds per square inch.
13,000	.....	.330	.026	.....	
14,000	.....	.358	.028	.....	
15,000	.....	.385	.027	.....	
16,000	.....	.414	.029	.016	Cracked.
26,800	7,890	.....	.....	.....	Ultimate strength.

Split along the grain diagonally about three-fourths of the length of the beam.

No. 723.

Marks, 46.
Length, 12 feet.
Breadth, 2″.67.
Depth, 7″.48.
Weight, 61 pounds. Weight per cubic foot, 36.67 pounds.
Rate of growth, 12 rings per inch.



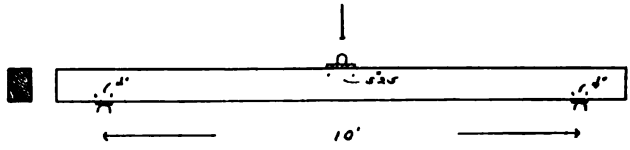
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
1,000	.....	.156	.156	.001	
2,000	.....	.347	.191	.008	
3,000	.....	.541	.194	.009	E (1,000-3,000)=2,051,000 pounds per square inch.
4,000	.....	.744	.203	.012	
5,000	.....	.939	.195	.015	
6,000	.....	1.139	.200	.....	
6,200	.....	1.175	.036	.....	
6,400	.....	1.217	.042	.....	
6,600	.....	1.257	.040	.....	
6,800	.....	1.300	.043	.....	
7,000	.....	1.343	.043	.....	
8,800	10,610	.....	.....	.....	Ultimate strength.

Fractured on the tension side and split along the grain toward one end.

No. 711.

Marks, 48. (First specimen.)
Length, 12 feet.
Breadth, 5″.70.
Depth, 7″.48.
Weight, 115 pounds. Weight per cubic foot, 32.37 pounds.
Rate of growth, 14 rings per inch.



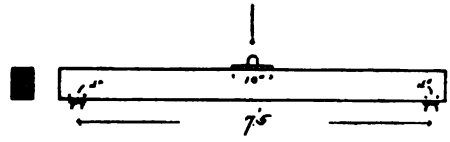
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.048	.048	.....	
2,000	.....	.141	.093	.006	
3,000	.....	.233	.092	.....	
4,000	.....	.332	.099	.010	
5,000	.....	.423	.091	.....	
6,000	.....	.516	.093	.012	
7,000	.....	.612	.096	.....	
8,000	.....	.709	.097	.013	E (2,000–8,000)=1,937,000 pounds per square inch.
9,000	.....	.804	.095	.....	
10,000	.....	.901	.097	.014	
11,000	.....	1.004	.103	.....	
12,000	.....	1.108	.104	.026	
13,000	.....	1.245	.137	.....	
18,900	10,670	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side, with crushing of the fibers at the ends of the middle shoe.

No. 733.

Marks, 48. (Second specimen.)
Length, 8.2 feet.
Breadth, 5″.69.
Depth, 7″.47.
Weight, 78 pounds. Weight per cubic foot, 32.23 pounds.
Rate of growth, 14 rings per inch.



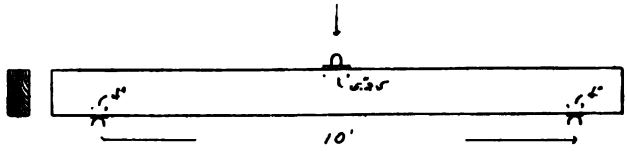
Ends supported 7.5 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.023	.023	.....	
2,000	.....	.066	.043	.002	
3,000	.....	.109	.043	.....	
4,000	.....	.152	.043	.005	
5,000	.....	.191	.039	.....	
6,000	.....	.235	.044	.007	
7,000	.....	.276	.041	.....	
8,000	.....	.319	.043	.010	
9,000	.....	.360	.041	.....	
10,000	.....	.403	.043	.013	
11,000	.....	.445	.042	.....	
12,000	.....	.489	.044	.015	E (2,000–12,000) =1,874,000 pounds per square inch.
13,000	.....	.531	.042	.....	
14,000	.....	.575	.044	.....	
27,100	11,520	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side. Fibers crushed at the middle bearing.

No. 709.

Marks, 52.
Length, 12.02 feet.
Breadth, 4″.72.
Depth, 11″.51.
Weight, 178 pounds. Weight per cubic foot, 39.25 pounds.
Rate of growth, 7 rings per inch.



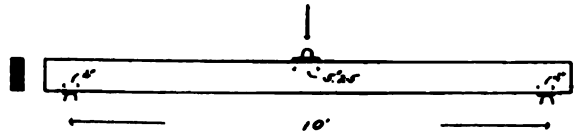
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.017	.017	.....	
2,000	.....	.050	.033	.....	
3,000	.....	.081	.031	.....	
4,000	.....	.114	.033	.....	
5,000	.....	.145	.031	.....	
6,000	.....	.176	.031	.....	
7,000	.....	.206	.030	.....	
8,000	.....	.237	.031	.....	
9,000	.....	.268	.031	.....	
10,000	.....	.299	.031	.....	
11,000	.....	.330	.031	.....	
12,000	.....	.361	.031	.....	E (2,000–12,000)=1,930,000 pounds per square inch.
13,000	.....	.392	.031	.....	
14,000	.....	.423	.031	.....	
15,000	.....	.454	.031	.....	
16,000	.....	.485	.031	.....	
17,000	.....	.516	.031	.....	
18,000	.....	.549	.033	.....	
19,000	.....	.579	.030	.....	
20,000	.....	.609	.030	.....	
21,000	.....	.641	.032	.....	
22,000	.....	.674	.033	.....	
23,000	.....	.707	.033	.....	
24,000	.....	.741	.034	.....	
25,000	.....	.775	.034	.....	
26,000	.....	.810	.035	.....	
27,000	.....	.854	.044	.....	Cracked.
37,900	10,900	.....	.....	.....	Ultimate strength.

Sheared along the grain nearly the whole length of the stick.
Fibers crushed at middle bearing.

No. 721.

Marks, 59. (First specimen.)
Length, 11.1 feet.
Breadth, 2″.73.
Depth, 7″.60.
Weight, 50 pounds. Weight per cubic foot, 31.22 pounds.
Rate of growth, 19 rings per inch.



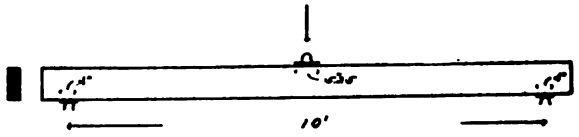
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
400	.....	.048	.048	.....	
600	.....	.089	.041	.....	
800	.....	.133	.044	.....	
1,000	.....	.176	.043	.002	
2,000	.....	.389	.213	.007	
3,000	.....	.607	.218	.013	E (1,000–3,000) = 1,717,000 pounds per square inch.
4,000	.....	.830	.223	.016	
5,000	.....	1.049	.219	.019	
5,200	.....	1.095	.046	.....	
5,400	.....	1.143	.048	.....	
5,600	.....	1.190	.047	.....	
5,800	.....	1.236	.046	.....	
6,000	.....	1.286	.050	.....	
8,800	10,050	.....	.....	.....	Ultimate strength.

Split along the grain diagonally from middle of tension side to about 2 feet from one end. Fibers crushed in vicinity of middle bearing.

No. 722.

Marks, 59. (Second specimen.)
Length, 11.14 feet.
Breadth, 2″.69.
Depth, 7″.76.
Weight, 48 pounds. Weight per cubic foot, 29.71 pounds.
Rate of growth, 19 rings per inch.



Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
1,000	.....	.183	.183	.001	
2,000	.....	.404	.221	.002	
3,000	.....	.633	.229	.004	E (1,000-3,000)=1,588,000 pounds per square inch.
4,000	.....	.865	.232	.007	
5,000	.....	1.108	.243	.....	
5,200	.....	1.159	.051	.....	
5,400	.....	1.211	.052	.....	
5,600	.....	1.263	.052	.....	
5,800	.....	1.331	.068	.....	
6,000	.....	1.388	.057	.....	
8,500	9,490	.....	.....	.....	Ultimate strength.

Splintering fracture on tension side. Fibers crushed in vicinity of middle bearing.

TABULATION OF TRANSVERSE TESTS OF DOUGLAS FIR WOOD.

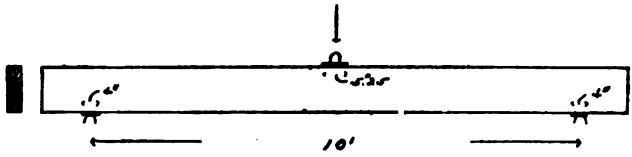
No. of test.	Marks.	Weight per cubic foot.	Rings per inch.	Dimensions.			Modulus of—		Remarks.
				Breadth.	Depth.	Span.	Elasticity, per square inch.	Rupture, per square inch.	
		Pounds.		*Inches.*	*Inches.*	*Feet.*	*Pounds.*	*Pounds.*	
717	7	32.33	12	7.59	7.58	10	1,825,000	11,470	First specimen.
734	7	35.72	12	7.37	7.44	7.5	1,943,000	12,110	Second specimen.
718	12	33.43	11	7.57	7.54	10	1,777,000	10,000	
707	13	34.35	9	5.50	13.40	10	1,285,000	7,470	
720	15	33.98	23	2.80	7.65	10	1,918,000	11,200	First specimen.
719	15	33.97	23	2.86	7.50	10	1,930,000	8,610	Second specimen.
712	22	35.74	12	4.53	4.51	10	2,305,000	9,570	Tested perpendicular to rings of growth.
713	22	35.63	12	4.49	4.50	10	2,218,000	8,910	Tested parallel to rings of growth.
708	28	33.74	14	5.52	13.35	10	1,436,000	8,780	
714	31	33.92	17	4.90	4.87	10	1,875,000	8,290	Tested perpendicular to rings of growth.
715	31	33.89	17	4.81	4.86	10	1,885,000	8,080	Tested parallel to rings of growth.
716	34	29.62	11	3.80	9.70	10	1,102,000	6,950	First specimen.
736	34	30.08	11	3.78	9.70	7.5	1,277,000	8,840	Second specimen.
710	40	36.04	18	3.70	11.15	10	1,625,000	6,460	First specimen.
735	40	33.00	18	3.70	11.13	7.5	1,342,000	7,890	Second specimen.
723	46	36.67	12	2.67	7.48	10	2,051,000	10,610	
711	48	32.37	14	5.70	7.48	10	1,937,000	10,670	First specimen.
733	48	32.23	14	5.69	7.47	7.5	1,874,000	11,520	Second specimen.
709	52	39.25	7	4.72	11.51	10	1,930,000	10,900	
721	59	31.22	19	2.73	7.60	10	1,717,000	10,050	First specimen.
722	59	29.71	19	2.69	7.76	10	1,538,000	9,490	Second specimen.

White Oak Wood.

DETAILS OF TRANSVERSE TESTS.

No. 724.

Marks, I.
Length, 12 feet.
Breadth, 3″.20.
Depth, 11″.03.
Weight, 137 pounds. Weight per cubic foot, 46.60 pounds.
Rate of growth, 16 rings per inch.



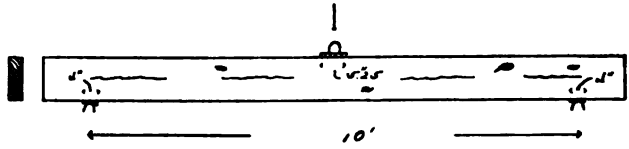
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.034	.034	.....	
2,000	.....	.096	.062	.003	
3,000	.....	.160	.064	.....	
4,000	.....	.222	.062	.005	
5,000	.....	.284	.062	.....	
6,000	.....	.345	.061	.008	
7,000	.....	.409	.064	.....	
8,000	.....	.477	.068	.016	
9,000	.....	.544	.067	.....	
10,000	.....	.612	.068	.027	E (2,000–10,000)=1,636,000 pounds per square inch.
11,000	.....	.686	.074	.....	
12,000	.....	.767	.081	.046	
13,000	.....	.846	.079	.....	
14,000	.....	.933	.087	.....	
15,000	.....	1.032	.099	.....	
23,800	11,010	.....	.....	.....	Ultimate strength.

Fractured on the tension side and crushed fibers on the compression side under the middle shoe, where the wood was indented $\frac{1}{8}$″.

No. 725.

Marks, II.
Length, 12.01 feet.
Breadth, 3″.37.
Depth, 10″.90.
Weight, 149 pounds. Weight per cubic foot, 48.64 pounds.
Rate of growth, 9 rings per inch.



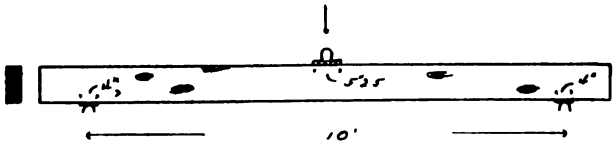
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.029	.029	.....	
2,000	.....	.087	.058	.002	
3,000	.....	.136	.049	.....	
4,000	.....	.189	.053	.004	
5,000	.....	.240	.051	.....	
6,000	.....	.293	.053	.005	
7,000	.....	.346	.053	.....	
8,000	.....	.399	.053	.009	
9,000	.....	.451	.052	.....	
10,000	.....	.506	.055	.011	
11,000	.....	.558	.052	.....	
12,000	.....	.614	.056	.014	E (2,000–12,000) = 1,588,000 pounds per square inch.
13,000	.....	.674	.060	.....	
14,000	.....	.735	.061	.023	
15,000	.....	.790	.055	.....	
16,000	.....	.858	.068	.....	
27,600	12,410	.....	.....	.....	Ultimate strength.

Splintering fracture on tension side. Fibers crushed in the vicinity of the middle bearing.

No. 726.

Marks, III.
Length, 12.01 feet.
Breadth, 3″.62.
Depth, 8″.93.
Weight, 126 pounds. Weight per cubic foot, 46.73 pounds.
Rate of growth, 11 rings per inch.



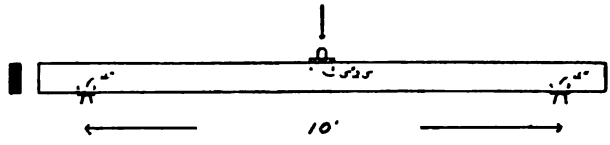
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.047	.047	.....	
2,000	.....	.137	.090	.001	
3,000	.....	.234	.097	.....	
4,000	.....	.326	.092	.004	
5,000	.....	.418	.092	.....	
6,000	.....	.512	.094	.006	
7,000	.....	.604	.092	.....	
8,000	.....	.696	.092	.011	E (2,000–8,000)=1,827,000 pounds per square inch.
9,000	.....	.795	.099	.....	
10,000	.....	.895	.100	.020	
11,000	.....	1.004	.109	.....	
12,000	.....	1.126	.122	.....	
13,000	.....	1.242	.116	.....	
19,700	12,280	.....	.....	.....	Ultimate strength.

Splintering fracture on tension side of beam. Slight crushing at middle bearing.

No. 727.

Marks, IV.
Length, 12 feet.
Breadth, 2″.53.
Depth, 7″.15.
Weight, 62 pounds. Weight per cubic foot, 41.15 pounds.
Rate of growth, 12 rings per inch.



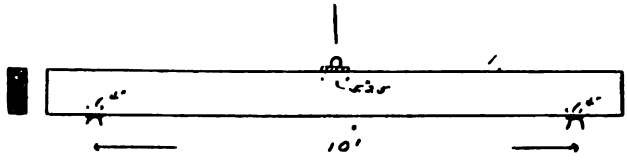
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
200	.....	0.	0.	.....	Initial load.
400	.....	.065	.065	.....	
600	.....	.128	.063	.....	
800	.....	.190	.062	.....	
1,000	.....	.254	.064	.001	
2,000	.....	.564	.310	.002	
3,000	.....	.878	.314	.006	E (1,000–3,000)=1,497,000 pounds per square inch.
4,000	.....	1.236	.358	.....	
4,200	.....	1.311	.075	.....	
4,400	.....	1.389	.078	.....	
4,600	.....	1.468	.079	.....	
4,800	.....	1.548	.080	.....	
5,000	.....	1.655	.107	.....	
8,300	11,550	.....	.....	.....	Ultimate strength.

Fractured on the tension side, accompanied by shearing along the grain.

No. 728.

Marks, V.
Length, 11.98 feet.
Breadth, 4″.59.
Depth, 11″.18.
Weight, 184 pounds. Weight per cubic foot, 43.08 pounds.
Rate of growth, 11 rings per inch.



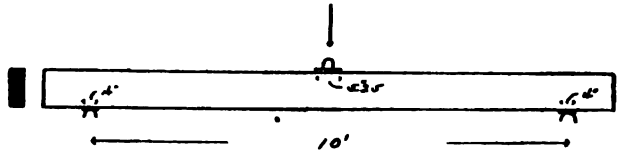
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.023	.023	.....	
2,000	.....	.074	.051	.001	
3,000	.....	.124	.050	.....	
4,000	.....	.173	.049	.002	
5,000	.....	.221	.048	.....	
6,000	.....	.272	.051	.005	
7,000	.....	.321	.049	.....	
8,000	.....	.370	.049	.006	
9,000	.....	.419	.049	.....	
10,000	.....	.469	.050	.008	
11,000	.....	.518	.049	.....	
12,000	.....	.568	.050	.012	E (2,000–12,000) = 1,394,000 pounds per square inch.
13,000	.....	.615	.047	.....	
14,000	.....	.665	.050	.014	
15,000	.....	.723	.058	.....	
16,000	.....	.783	.060	.025	
17,000	.....	.832	.049	.....	
18,000	.....	.891	.059	.....	
19,000	.....	.951	.060	.....	
20,000	.....	1.017	.066	.....	
32,200	10,110	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side.

No. 729.

Marks, VI.
Length, 12 feet.
Breadth, 3″.39.
Depth, 9″.28.
Weight, 110 pounds. Weight per cubic foot, 41.97 pounds.
Rate of growth, 15 rings per inch.



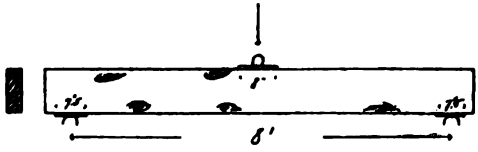
Ends supported 10 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inches.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.061	.061	.....	
2,000	.....	.179	.118	.001	
3,000	.....	.299	.120	.....	
4,000	.....	.419	.120	.002	E (2,000–4,000)=1,334,000 pounds per square inch.
5,000	.....	.538	.119	.....	
6,000	.....	.653	.115	.004	
7,000	.....	.773	.120	.....	
8,000	.....	.901	.128	.010	
9,000	.....	1.042	.141	.....	
10,000	.....	.....	.....	.....	
14,600	9,010	.....	.....	.....	Ultimate strength.

Splintering fracture on the tension side.

No. 730.

Marks, VII.
Length, 9.01 feet.
Breadth, 3″.40.
Depth, 11″.01.
Weight, 108 pounds. Weight per cubic foot, 46.12 pounds.
Rate of growth, 8 rings per inch.



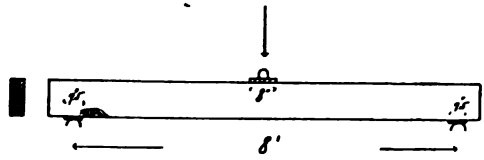
Ends supported 8 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.024	.024	.....	
2,000	.....	.068	.044	.001	
3,000	.....	.112	.044	.....	
4,000	.....	.154	.042	.008	
5,000	.....	.199	.045	.....	
6,000	.....	.244	.045	.006	
7,000	.....	.290	.046	.....	
8,000	.....	.335	.045	.009	
9,000	.....	.379	.044	.....	
10,000	.....	.424	.045	.015	E (2,000–10,000) = 1,140,000 pounds per square inch.
11,000	.....	.470	.046	.....	
12,000	.....	.517	.047	.020	
13,000	.....	.567	.050	.....	
14,000	.....	.617	.050	.....	
23,400	8,180	.....	.....	.....	Ultimate strength.

Tension fracture, starting at a knot.

No. 731.

Marks, VIII.
Length, 9 feet.
Breadth, 3″.46.
Depth, 9″.10.
Weight, 99 pounds. Weight per cubic foot, 50.31 pounds.
Rate of growth, 15 rings per inch.



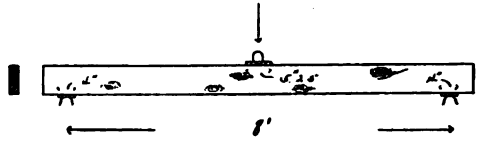
Ends supported 8 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.028	.028	.....	
2,000	.....	.083	.055	.003	
3,000	.....	.136	.053	.....	
4,000	.....	.192	.056	.008	
5,000	.....	.246	.054	.....	
6,000	.....	.301	.055	.010	
7,000	.....	.355	.054	.....	
8,000	.....	.409	.054	.013	
9,000	.....	.463	.054	.....	
10,000	.....	.520	.057	.018	
11,000	.....	.578	.058	.....	
12,000	.....	.636	.058	.026	E (2,000–12,000)=1,604,000 pounds per square inch.
13,000	.....	.696	.060	.....	
14,000	.....	.757	.061	.....	
30,300	15,230	.....	.....	.....	Ultimate strength.

Fractured on the tension side, accompanied by shearing along the grain.

No. 732.

Marks, IX.
Length, 9 feet.
Breadth, 2″.39.
Depth, 6″.97.
Weight, 53.5 pounds. Weight per cubic foot, 51.39 pounds.
Rate of growth, 15 rings per inch.



Ends supported 8 feet apart. Loaded at the middle.
Deflections measured at the middle.

Applied loads.		Deflections.	Successive deflections.	Deflection sets.	Remarks.
Total.	Maximum fiber stress per square inch.				
Pounds.	*Pounds.*	*Inch.*	*Inch.*	*Inch.*	
500	.....	0.	0.	.....	Initial load.
1,000	.....	.077	.077	.....	
2,000	.....	.228	.151	.007	
3,000	.....	.386	.158	.....	
4,000	.....	.549	.163	.017	E (2,000–4,000) = 1,758,000 pounds per square inch.
5,000	.....	.723	.174	.....	
6,000	.....	.927	.204	.....	
9,500	11,780	.....	.....	.....	Ultimate strength.

Fractured on the tension side. Fibers crushed near middle bearing.

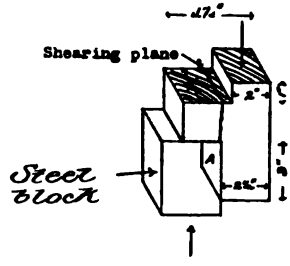
TABULATION OF TRANSVERSE TESTS OF WHITE-OAK WOOD.

No. of test.	Marks.	Weight per cubic foot.	Rings per inch.	Dimensions.			Modulus of—	
				Breadth.	Depth.	Span.	Elasticity, per square inch.	Rupture, per square inch.
		Pounds.		*Inches.*	*Inches.*	*Feet.*	*Pounds.*	*Pounds.*
724	I	46.60	16	3.20	11.03	10	1,636,000	11,010
725	II	48.64	9	3.37	10.90	10	1,538,000	12,410
726	III	46.78	11	3.62	8.98	10	1,827,000	12,280
727	IV	41.15	12	2.53	7.15	10	1,497,000	11,550
728	V	43.08	11	4.59	11.18	10	1,394,000	10,110
729	VI	41.97	15	3.39	9.28	10	1,334,000	9,010
730	VII	46.12	8	3.40	11.01	8	1,140,000	8,180
731	VIII	50.31	15	3.46	9.10	8	1,604,000	15,230
732	IX	51.39	15	2.39	6.97	8	1,758,000	11,780

Douglas Fir Wood.

SHEARING TESTS.

Specimen with one shearing plane.



Face A lubricated.

Specimens with the same shearing area were taken from the same stick of timber and numbered 1, 2, 3, and 4 across the stick, and were side by side in the timber.

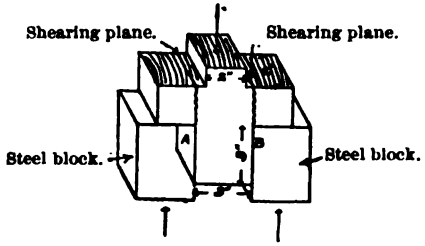
Rings of growth about 45° with shearing plane.

No.	Dimensions of shearing plane.		Area of shearing plane.	Shearing strength.			Remarks.
				Total.	Per square inch.	Mean.	
	Inches.	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
1	2.05	2.04	4.18	1,750	419	.....	
2	2.06	2.04	4.20	2,000	476	.....	
3	2.04	2.04	4.16	1,700	408	.....	
4	2.06	2.05	4.22	1,970	467	443	
1	2.04	3.00	6.12	3,220	526	.....	
2	2.04	3.00	6.12	3,250	531	.....	
3	2.03	3.00	6.09	3,100	509	.....	
4	2.03	3.00	6.09	3,280	539	521	
1	2.04	4.00	8.16	3,980	488	.....	
2	2.04	4.00	8.16	3,820	468	.....	
3	2.04	4.00	8.16	3,910	479	.....	
4	2.03	4.00	8.12	4,190	516	488	
1	2.04	4.98	10.16	6,400	630	.....	
2	2.06	4.98	10.26	5,100	497	.....	
3	2.03	4.99	10.13	5,500	543	.....	
4	2.03	5.00	10.15	4,700	463	533	
1	2.00	8.33	16.66	8,100	486	.....	
2	2.04	6.00	12.24	5,800	474	.....	
3	2.04	6.00	12.24	6,000	490	.....	
4	2.04	6.00	12.24	5,720	476	479	

Rings of growth perpendicular to shearing plane.
Specimens marked No. 1 were nearer the heart of the tree than those marked No. 2.

No.	Dimensions of shearing plane.		Area of shearing plane.	Shearing strength.			Remarks.
				Total.	Per square inch.	Mean.	
	Inches.	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
1	2.00	4.00	8.00	3,500	438	.....	
2	2.00	4.00	8.00	4,300	538	488	
1	2.00	4.10	8.20	3,600	439	.....	
2	2.00	4.10	8.20	4,600	561	500	

Specimens with two shearing planes.

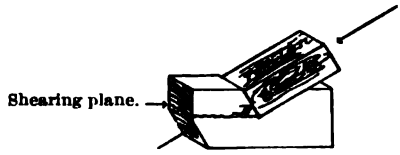


Faces A and B lubricated.

Rings of growth nearly parallel to planes of shearing.
Specimens 1 and 2 were side by side in the timber.

No.	Dimensions of shearing plane.		Area of two planes.	Shearing strength.			Remarks.
				Total.	Per square inch.	Mean.	
	Inches.	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	*Pounds.*	
1	1.99	2.01	8.00	2,800	350	.....	
2	2.01	2.01	8.08	3,000	371	361	
1	2.00	3.00	12.00	4,700	392	.....	
2	2.01	3.00	12.06	4,600	381	387	
1	3.99	2.00	15.96	5,850	367	.....	
2	3.99	2.00	15.96	4,900	307	337	Followed rings closely.
1	2.00	5.00	20.00	5,950	298	.....	
2	2.01	5.00	20.10	6,300	313	306	
1	2.00	6.02	24.08	7,580	315	.....	
2	2.01	6.04	24.28	10,100	416	366	Both sides yielded at once.

SHEARING TESTS OF DOUGLAS FIR WOOD WITH OBLIQUE LOADS.



No.	Dimensions of shearing plane.		Area of shearing plane.	Direction of shearing plane to rings of growth.	Pressure applied at angle with shearing plane of.	Yielded along line.	Shearing strength.	
							Total.	Per square inch.
	Inches.	*Inches.*	*Sq. ins.*		°		*Pounds.*	*Pounds.*
1	3.75	11.00	41.25	45 degrees.....	30	A–B	58,900	1,430
2	3.75	8.00	30.00	Parallel.....	45	A–B	39,000	1,300
3	4.68	7.90	36.97	Perpendicular	45	See note .	39,200	1,060
4	4.72	12.95	61.12	.....do.....	30	A–B	73,900	1,209
5	4.72	22.50	106.20	.....do.....	15	A–B	75,600	712
6	2.75	7.40	20.35	Nearly perpendicular.	45	A–B	26,400	1,297
7	2.75	10.00	27.50	.....do.....	30	A–B	35,400	1,287
8	2.75	17.84	49.06	.....do.....	15	A–B	42,800	872

Note.—No. 3 sheared on area 4″.68×10″.30=48.20 square inches. Nos. 3, 4, and 5 were all from the same piece of timber.

Heat conductivity of sticks of Douglas fir wood, charred over open wood fires, and stick exposed to low temperature.

Test No. 3.

Wood fire used. Dimensions of stick, 10″×10″×4′. A hole 1″ in diameter was bored to a depth of 2 feet in one end of this stick. Observations of the temperature at the middle of the stick taken with a mercury thermometer with its bulb at the bottom of the 1-inch hole. Stick turned over the fire, so as to burn all sides evenly.

Time.	Temperature.	Remarks.
Hrs. min.	° *C.*	
0 0	18	Put on fire.
30	17	
45	16	Pitch oozed out to a depth of 1″ below sides, at end of stick.
1 00	17	
1 30	20	
1 35	22	
1 40	22.5	Pitch oozed out to a depth of 2″ below sides, at end of stick.
1 50	27	
1 55	29	
2 00	30	
2 05	32	
2 10	35	Pitch oozed out to a depth of 4″ below sides, at end of stick.
2 15	39	
2 20	44	
2 25	45	
2 30	51	Taken off fire and quenched with water.
2 35	56	
2 40	59	
2 45	60	
2 50	64	
2 55	70	
3 00	73	
3 05	78	Does not feel warm to hand on outside.
3 10	82	
3 15	86	
3 20	89	
3 25	92	
3 35	96	
3 40	98	
3 45	100	
3 50	102	Maximum temperature, 1 hour 20 minutes after taking from fire.
3 55	98	
4 00	96	

Test discontinued.

Dimensions after charcoal had been scraped off, 6″.3×6″.2, with rounded corners.

Test No. 4.

Observations taken as in No. 3.
Temperature of fire, 750° C.
Dimensions of stick, 10″×10″×4′.

Time.		Temperature.	Remarks.
Hrs.	*Min.*	°*C.*	
0	0	18	Put on fire
	15	17.5	
	30	18	
	45	18	
1	00	20	
1	15	22	
1	30	27	
1	45	30	Quenched with water and returned to fire.
2	00	40	Do.
2	15	48	Do.
2	30	60	Do.
2	45	68	Do.
3	00	68	Taken from fire and quenched with water.
3	30	78	
4	00	82	
4	30	82	
5	00	80	

Test discontinued.
Dimensions after charcoal was scraped off, 7″.4×7″.2 at one end and 6″.5×6″.5 at the other, with rounded corners.

Test No. 5.

Observations taken as in No. 3.
Dimensions of stick, 10″×10″×3′.

Time.		Temperature.	Remarks.
Hrs.	*Min.*	°*C.*	
0	0	18	Put on fire.
	15	18	
	30	18	
	45	20	
1	00	20	
1	15	20.5	
1	30	25	
1	45	31	
2	00	37	
2	15	44	Taken from fire and quenched.
2	30	54	
2	45	61	
3	00	69	
3	15	78	

Test discontinued.
Dimensions after charcoal was scraped off, 6″.7×6″.9.

Test No. 6.

Observations taken as in No. 3.
Dimensions of stick, 10″×10″×4′.

Time.	Temperature.	Remarks.
Hrs. Min.	°*C.*	
0 0	16	Put on fire.
15	15.5	
30	16	
45	16	
1 00	16	
1 15	18	
1 30	21	
1 45	26	
2 00	36	
2 15	43	
2 30	52	Taken from fire, but not quenched.
2 45	66	
3 00	82	
3 15	89	
3 30	96	
3 45	108	
4 00	104	
4 15	104	
4 30	105	
4 45	105	
5 00	105.5	
5 15	106	
5 30	106	
5 45	106	
6 00	107	
6 30	106	
7 00	104	

Test discontinued.
Dimensions after charcoal was scraped off, 6″×6″.4, with rounded corners.

Test No. 7.

Observations taken as in No. 3.
Dimensions of stick, 10″×10″×4′, with 2″ hole at one end.

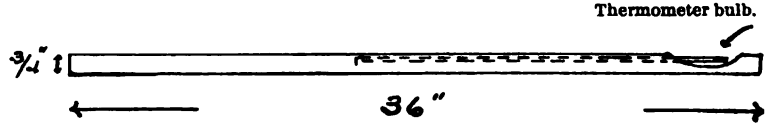
Time.	Temperature.	Remarks.
Hrs. Min.	°*C.*	
0 0	19	Put on fire.
15	19	
30	20	
45	20	
1 00	20.5	
1 15	21	
1 30	24	
1 45	27	
2 00	32	
2 15	40	
2 30	48	Taken from fire and smothered with sand and ashes.
2 45	60	
3 00	71	
3 15	90	
3 30	96	
4 00	105	
4 30	107	
4 45	109	
5 00	107	
5 15	107	
5 30	105	
5 45	104	
6 00	101	
6 15	99	
6 30	96	
6 45	95	
7 00	92	
7 15	89	
7 30	86	
7 45	84	
8 00	82	
8 15	79	
8 30	77	
24 00	24	Temperature of 17° C. on outside.

Dimensions after charcoal had been scraped off, 6″.3×5″.9, with rounded corners. Fire burned down 1″ deeper in two places than these dimensions show.

TEST No. 8.

Dimensions of stick, 10″×10″×4′, with a 1″ hole 2 feet long bored in one end.

Observations taken with mercury thermometer with bulb not in immediate contact with the wood, as in former tests.



Time.	Temperature.	Remarks.
Hrs. Min.	°C.	
.....	18.5	Temperature before putting on fire.
0 0	18.5	Put on fire.
15	18.5	
30	18.5	
45	19	
1 00	20	Taken from fire and smothered.
1 15	22	
1 30	25	
1 45	27	
2 00	30	Put on fire second time.
2 15	38	
2 30	43	
2 45	46	
3 00	48	Taken from fire and smothered.
3 15	52	
3 30	57	
3 45	64	
4 00	70	Put on fire third time.
4 15	78	
4 30	81	
4 45	85	
5 00	88	Taken from fire and smothered.
5 15	97	
5 30	102	
5 45	103	
6 00	105	
6 15	105	
6 30	105	
6 45	104	
7 00	104	
7 15	103	
7 30	103	
7 45	101	
8 00	99	
8 15	98	
8 30	97	

Test discontinued.

DOUGLAS FIR IN COLD STORAGE.

Size of stick, 10″×10″×4′, with 1″ hole 2 feet long in one end. Taken from temperature of 60° F. and placed in cold storage.

Time.	Date.	Temperature of stick.	Temperature of room.	Time in cold storage.	Remarks.
	1902.	°F.	°F.	*Hours.*	
8.45 a. m ..	May 8	60	−1	0	
10.45 a. m ..	....do ...	60	−1	2	
12.00 m.....	....do ...	55	0	3.25	
2.45 p. m ..	....do ...	41	−1	6	
4.45 p. m ..	....do ...	32.5	−1	8	
8.45 a. m ..	May 9	4	−1.5	24	
4.45 p. m ..	....do. ..	2	−2.5	32	Then taken out and hole corked.

Stick taken from cold storage at a temperature of zero F. at 12 m., May 14, 1902.

Time.	Date.	Temperature of stick.	Temperature of room.	Time in air at 68° F.	Remarks.
	1902.	°F.	°F.	*Hours.*	
2.00 p. m ..	May 14	.....	68	2	
3.00 p. m ..	....do ...	12.7	68	3	
4.00 p. m ..	....do ...	18.5	68	4	
8.00 a. m ..	May 15	62.6	68	20	
11.00 a. m ..	....do ...	64.4	68	23	
4.00 p. m ..	....do ...	66.2	68	28	

COMPRESSION TESTS OF DOUGLAS FIR POSTS TURNED DOWN FROM 10″×10″ STICKS WHICH HAD BEEN CHARRED OVER A WOOD FIRE.

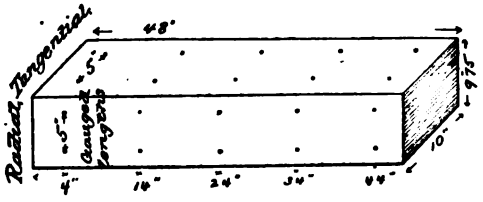
Posts had a 1″ hole in the center, which was bored in order to take the temperature while the stick was charring. The area of this hole is deducted in computing sectional area.

Marks on posts.	Length.	Diameter.	Sectional area.	Ultimate strength.	
				Total.	Per square inch.
	Inches.	*Inches.*	*Square inches.*	*Pounds.*	*Pounds.*
3	24	4.97	18.61	133,500	7,170
4	24	5.82	25.82	183,200	7,100
5	18	5.40	22.12	148,200	6,700
6	24	4.54	15.40	117,100	7,600
7	24	4.40	14.42	85,900	5,960

Douglas Fir Wood.

Expansion crosswise the grain, and absorption of water after submersion different periods.

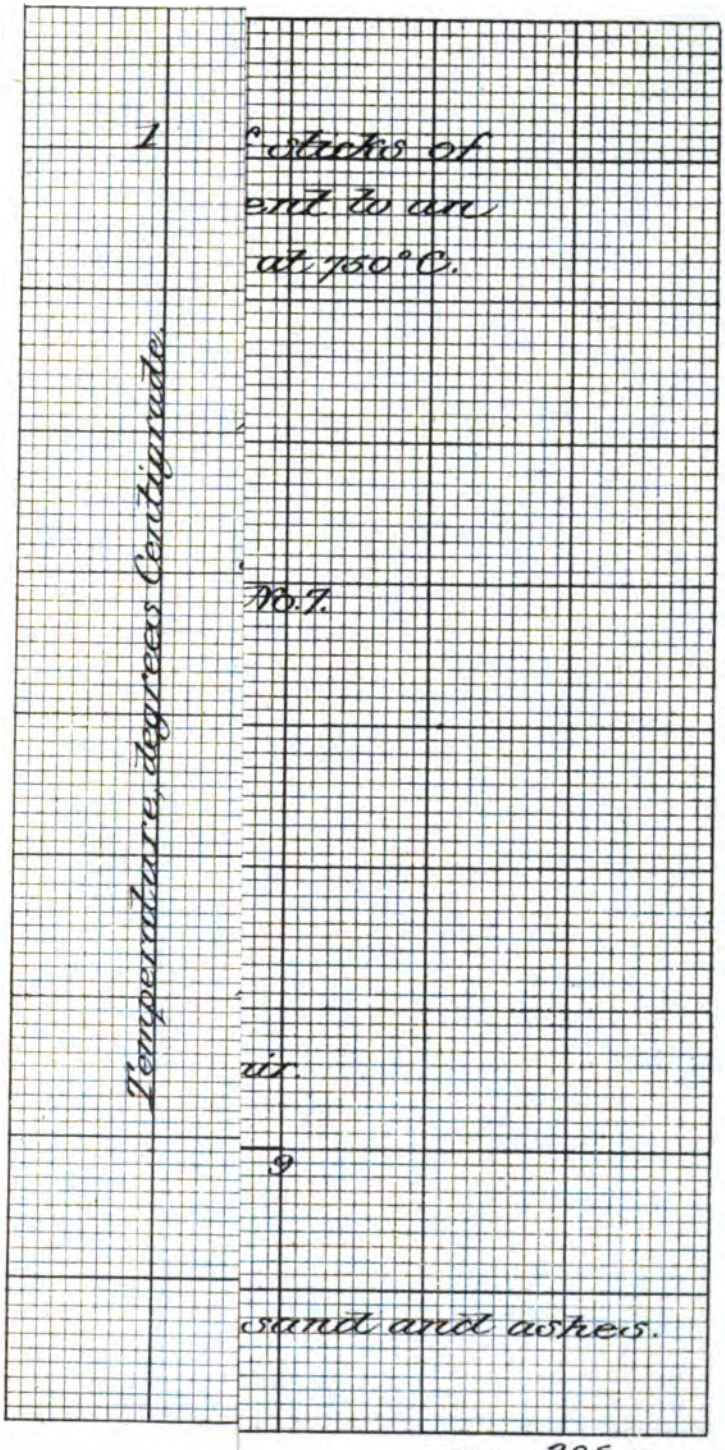
Original state of wood, air seasoned 8 years.



Gauged lengths, 5″ long each, established along the length of the stick 10″ apart, beginning 4″ from one end.

Weight of stick before submerged, 90.75 pounds.

Gauged lengths.	Weights, pounds, after periods submerged.						
	91.50	93.25	96.50	98.00	101.00	108.75	111.75
	Expansion after periods submerged of—						
	5 hours.	2 days.	5 days.	2 weeks.	4 weeks.	2 months.	3 months.
	Inch.	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*	*Inch.*
Tangential, 4	.0066	.0286	.0529	.1010	.1357	.1745	.1888
Tangential, 14	−.0008	.0103	.0253	.0620	.0909	.1292	.1457
Tangential, 24	.0057	.0236	.0414	.0787	.1069	.1430	.1592
Tangential, 34	−.0006	.0152	.0337	.0772	.1085	.1479	.1652
Tangential, 44	.0052	.0338	.0628	.1263	.1637	.2033	.2192
Radial, 4	.0045	.0114	.0200	.0429	.0633	.0892	.0985
Radial, 14	.0008	.0025	.0063	.0217	.0363	.0576	.0683
Radial, 24	.0011	.0044	.0071	.0204	.0326	.0533	.0631
Radial, 34	.0015	.0050	.0088	.0271	.0433	.0651	.0741
Radial, 44	.0029	.0126	.0220	.0509	.0727	.1000	.1086


1
Temperature, degrees Centigrade.
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No. 7.
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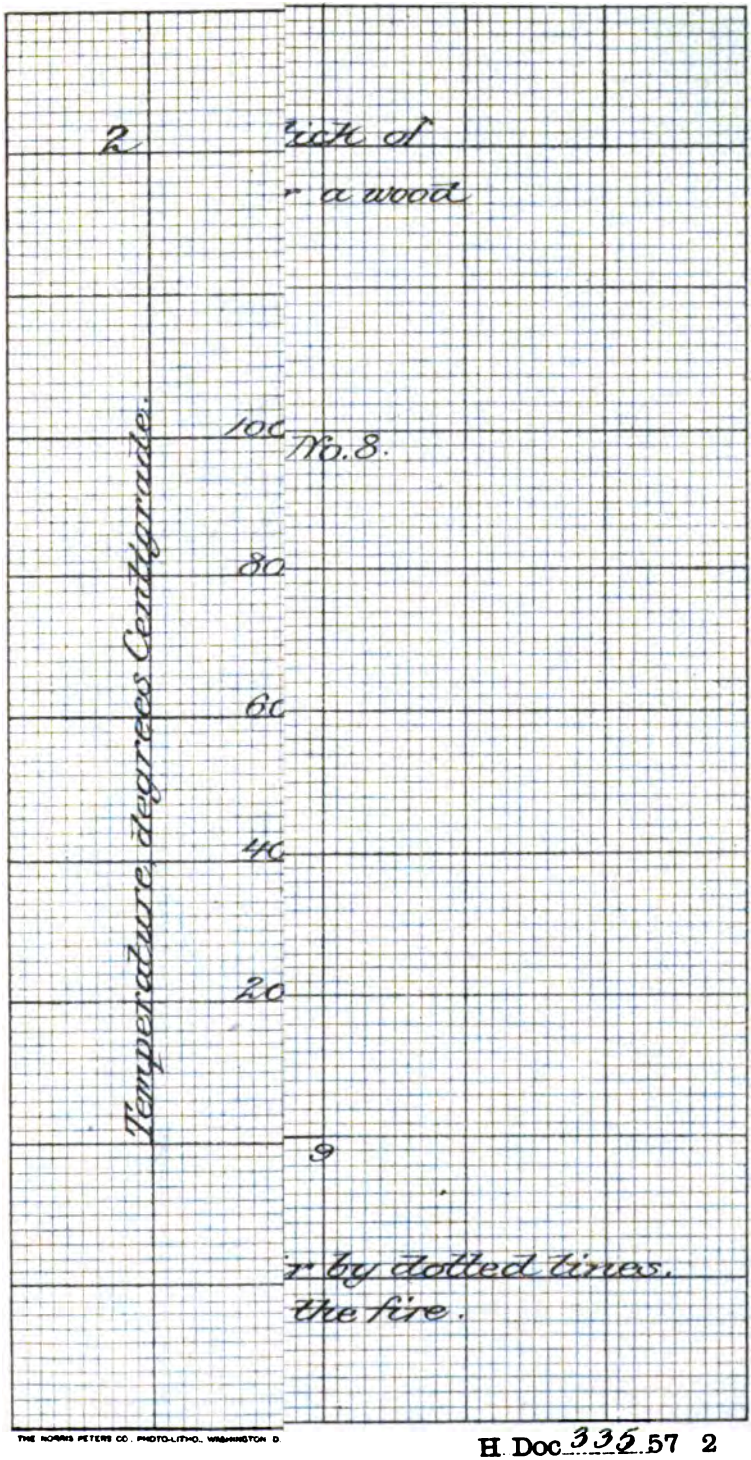
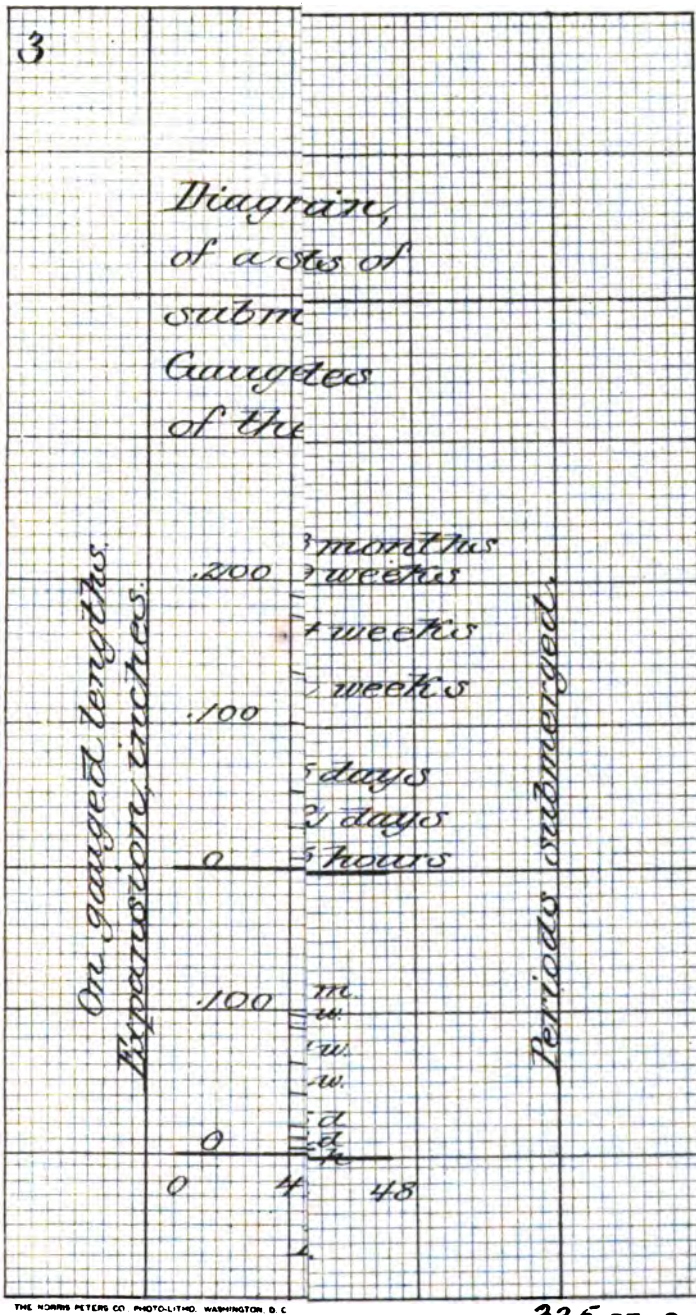
9
sand and ashes.



THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.



THE NORRIS PETERS CO. PHOTO-LITHO. WASHINGTON, D. C.

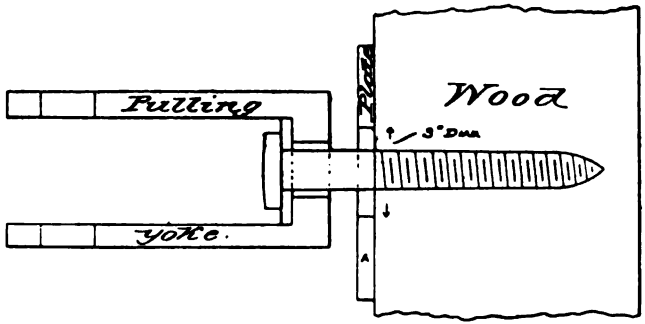
ADHESION OF LAG SCREWS AND BOLTS IN WOOD.

Tests of the Adhesion of Lag Screws in Douglas Fir and White Oak Wood.

Screws turned into the wood to the depth of their threaded portions.

Plate A used to prevent splintering of the wood.

Holes were bored in the wood to receive the screws.



Nominal size.		Dimensions.				Resisting area.	Kind of wood.	Diameter of bored hole.	Load at ¼" pull. Total.	Load at ½" pull. Total.	Load at ¾" pull. Total.	Adhesive resistance.		Remarks.
Diameter.	Length.	Diameters.		Length of thread.	Threads per inch.							Total.	Per square inch.	
		Body.	Root of thread.											
Inch.	*Inches*	*Inch.*	*Inch.*	*Inches.*		*Sq. inches.*		*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
⅜	4	.62	.46	2	5	3.90	Douglas Fir ..	7/16	1,900	1,100	.....	2,700	692	Wood split. Plate A not used.
⅜	4	.62	.46	2	5	3.90	.....do.....	1/2	2,400	1,200	.....	2,400	615	
⅜	4	.62	.46	2	5	3.90	.....do.....	⅜	2,300	1,600	200	2,500	641	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	7/16	5,100	4,200	1,200	5,900	804	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	1/2	5,100	2,600	500	5,710	778	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	⅜	6,100	4,000	1,000	6,600	899	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	⅜	5,500	3,600	1,100	6,100	831	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	7/16	5,200	3,800	1,800	6,500	886	
⅜	8	.73	.59	4.50	4.5	10.32	.....do.....	7/16	7,600	5,200	1,100	7,900	766	
⅜	8	.73	.59	4.50	4.5	10.32	.....do.....	⅜	7,000	5,400	1,400	7,700	746	
⅜	8	.73	.59	4.50	4.5	10.32	.....do.....	7/16	9,300	6,600	1,900	9,800	950	
⅜	9	.89	.66	4.90	4	13.70	.....do.....	⅜	12,100	10,500	5,000	12,200	891	
⅜	9	.89	.66	4.90	4	13.70	.....do.....	7/16	12,100	9,900	3,700	12,400	904	
⅜	9	.89	.66	4.90	4	13.70	.....do.....	⅜	11,100	8,500	3,700	12,400	904	

TESTS OF THE ADHESION OF LAG SCREWS IN DOUGLAS FIR AND WHITE OAK WOOD—Continued.

Nominal size.		Dimensions.						Diameter of bored hole.	Load at ¼" pull. Total.	Load at ½" pull. Total.	Load at ¾" pull. Total.	Adhesive resistance.		Remarks.
Diameter.	Length.	Diameters.		Length of thread.	Threads per inch.	Resisting area.	Kind of wood.					Total.	Per square inch.	
		Body.	Root of thread.											
Inch.	*Inches.*	*Inch.*	*Inch.*	*Inches.*		*Sq. inches.*		*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
¼	3	.48	.29	1.50	6	2.26	White Oak....	¼	2,400	1,500	200	3,700	1,640	Plate A not used.
¼	3	.48	.29	1.50	6	2.26	.....do.....	15/64	3,600	1,500	200	3,600	1,590	Do.
¼	3	.48	.29	1.50	6	2.26	.....do.....	2/8	3,500	1,100	300	3,500	1,550	Do.
7/32	3	.41	.34	1.50	6	1.93	.....do.....	15/64	2,400	1,200	100	3,400	1,760	Do.
7/32	3	.41	.34	1.50	6	1.93	.....do.....	2/8	3,600	.....	800	3,600	1,870	Do.
5/16	3½	.60	.47	2	5	3.77	.....do.....	17/64	6,600	3,500	400	6,800	1,800	Do.
5/16	3½	.60	.47	2	5	3.77	.....do.....	5/16	7,200	3,800	800	7,200	1,910	Do.
5/16	4	.62	.46	2.25	5	4.38	.....do.....	17/64	6,900	5,100	600	7,000	1,600	Do.
5/16	4	.62	.46	2.25	5	4.38	.....do.....	5/16	6,600	4,800	400	6,600	1,510	Do.
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	9/32	12,200	7,100	2,100	12,200	1,660	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	11/32	12,200	8,600	2,100	12,300	1,680	
⅜	6	.73	.56	3.20	4.5	7.34	.....do.....	17/64	.....	.....	.....	13,000	1,770	Lag screw broke. T. S. = 52,850 pounds per square inch at root of thread.
⅜	8	.73	.59	4.5	4.5	10.32	.....do.....	9/32	15,100	6,000	1,800	15,100	1,460	
⅜	8	.73	.59	4.5	4.5	10.32	.....do.....	5/16	13,900	9,500	2,000	14,300	1,390	
⅜	8	.73	.59	4.5	4.5	10.32	.....do.....	17/64	13,800	6,000	1,800	13,800	1,290	
7/16	9	.89	.66	4.90	4	13.70	.....do.....	5/16	17,800	6,400	.....	17,800	1,300	Screw was oiled on account of rust.
7/16	9	.89	.66	4.90	4	13.70	.....do.....	9/32	.....	.....	.....	.....	.....	Twisted off when turned into wood.

Thread No. 1.
Wood screw thread.

Thread No. 2.
Ratchet thread.

In column "Length of thread" is given the length of the full-size thread which was turned into the wood.

TESTS OF ¾″ LAG SCREWS IN DOUGLAS FIR.

Length of screw.	Description of screw.							Load at ¼″ pull. Total.	Load at ½″ pull. Total.	Load at ¾″ pull. Total.	Adhesive resistance.		Remarks.
	Diameters.		Length of thread.	Threads per inch.	Kind of thread.	Resisting area.	Diameter of bored hole.				Total.	Per square inch.	
	Body.	Root of thread.											
Inches.	*Inch.*	*Inch.*	*Inches.*			*Sq. inches.*	*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
4	.49	.37	2.3	5	No. 1..	3.54	¾	2,100	1,200	200	2,800	791	
4	.49	.37	2.3	5	No. 1..	3.54	7/16	2,300	1,200	200	2,500	706	
4	.49	.37	2.3	5	No. 1..	3.54	½	2,500	1,700	200	2,900	819	
4½	.49	.37	2.8	5	No. 1..	4.31	¾	3,100	2,000	300	3,500	812	
4½	.49	.37	2.8	5	No. 1..	4.31	7/16	3,000	.....	300	3,800	882	
4½	.49	.37	2.8	5	No. 1..	4.31	½	2,600	1,800	400	3,300	766	
5	.48	.37	2.9	5	No. 1..	4.37	¾	3,100	1,400	300	3,400	778	
5	.48	.37	2.9	5	No. 1..	4.37	7/16	2,800	1,500	200	3,700	847	
5	.48	.37	2.9	5	No. 1..	4.37	½	2,500	1,700	400	3,300	755	
5½	.46	.37	2.9	6	No. 2..	4.19	¾	2,900	1,100	400	3,500	835	
5½	.46	.37	2.9	6	No. 2..	4.19	7/16	3,000	1,500	600	3,700	883	
5½	.46	.37	2.9	6	No. 2..	4.19	½	3,200	1,600	400	3,800	907	
6	.48	.37	3	6½	No. 2..	4.52	¾	3,600	1,600	300	4,000	885	
6	.48	.37	3	6½	No. 2..	4.52	7/16	3,200	1,700	600	4,100	907	
6	.48	.37	3	6½	No. 2..	4.52	½	3,700	2,300	400	4,500	996	
7	.49	.37	3	5	No. 1..	4.62	¾	3,500	1,800	300	3,900	844	
7	.49	.37	3	5	No. 1..	4.62	7/16	3,200	2,100	700	4,000	866	
7	.49	.37	3	5	No. 1..	4.62	½	3,600	2,500	600	4,100	888	

TESTS OF ¼" LAG SCREWS IN DOUGLAS FIR—Continued.

Length of screw.	Description of screw.							Load at ¼" pull. Total.	Load at ½" pull. Total.	Load at ¾" pull. Total.	Adhesive resistance.		Remarks.
	Diameters.		Length of thread.	Threads per inch.	Kind of thread.	Resisting area.	Diameter of bored hole.				Total.	Per square inch.	
	Body.	Root of thread.											
Inches.	*Inch.*	*Inch.*	*Inches.*			*Sq inches.*	*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
6½	.48	.38	3.5	6½	No. 2..	5.28	¼	4,200	2,100	600	4,700	890	
6½	.48	.38	3.5	6½	No. 2..	5.28	5/16	4,100	2,400	700	4,900	928	
6½	.48	.38	3.5	6½	No. 2..	5.28	⅜	4,500	2,700	700	5,100	966	
8	.48	.37	3.5	5	No. 1..	5.28	¼	4,200	2,100	600	4,900	928	
8	.48	.37	3.5	5	No. 1..	5.28	5/16	3,100	2,400	800	5,400	1,020	
8	.48	.37	3.5	5	No. 1..	5.28	⅜	4,300	2,200	700	5,100	966	
8	.48	.37	3.5	5	No. 1..	5.28	5/16	5,100	2,400	700	6,200	1,170	This lag screw was screwed into the narrow side of a block 5" × 11" × 15". When tested the wood split 2" either side of the screw. Tested without plate A.

TESTS OF ¼" LAG SCREWS IN DOUGLAS FIR.

3½	.62	.47	2	5	No. 2..	3.90	¼	2,100	1,500	300	2,500	641	
3½	.62	.47	2	5	No. 2..	3.90	5/16	2,200	1,400	400	2,500	641	
3½	.62	.47	2	5	No. 2..	3.90	⅜	2,100	1,300	200	2,800	718	
4	.61	.48	2.2	5	No. 2..	4.22	¼	1,700	800	100	2,500	592	
4	.61	.48	2.2	5	No. 2..	4.22	5/16	1,900	1,300	500	2,500	592	
4	.61	.48	2.2	5	No. 2..	4.22	⅜	2,300	1,200	200	2,900	687	
4½	.62	.50	2.4	5	No. 2..	4.67	¼	2,100	700	100	2,300	493	
4½	.62	.50	2.4	5	No. 2..	4.67	5/16	2,000	1,100	200	2,400	514	
4½	.62	.50	2.4	5	No. 2..	4.67	⅜	1,900	1,500	800	2,300	493	
5	.61	.48	3	5	No. 1..	5.75	¼	3,100	1,700	400	3,200	556	
5	.61	.48	3	5	No. 1..	5.75	5/16	2,800	1,800	500	3,300	574	
5	.61	.48	3	5	No. 1..	5.75	⅜	3,100	1,700	500	3,300	574	
5½	.60	.46	3	5	No. 2..	5.66	¼	2,500	1,200	300	2,800	495	
5½	.60	.46	3	5	No. 2..	5.66	5/16	2,600	1,700	300	2,900	512	
5½	.60	.46	3	5	No. 2..	5.66	⅜	2,600	1,700	300	3,100	548	

6	.60	.47	3.5	5	No. 1..	6.60	¼	5,100	1,900	600	5,100	773		
6	.60	.47	3.5	5	No. 1..	6.60	⅜	4,900	2,300	800	5,400	818		
6	.60	.47	3.5	5	No. 1..	6.60	½	4,700	2,200	500	5,500	833		
7	.61	.48	3.9	5	No. 1..	7.47	¼	5,700	4,400	.....	5,800	776		
7	.61	.48	3.9	5	No. 1..	7.47	⅜	5,500	3,200	800	5,800	776		
7	.61	.48	3.9	5	No. 1..	7.47	½	6,000	4,300	700	6,800	843		
8	.62	.47	4.1	5	No. 1..	7.99	¼	6,200	2,800	600	6,400	801		
8	.62	.47	4.1	5	No. 1..	7.99	⅜	5,900	4,300	1,100	6,200	776		
8	.62	.47	4.1	5	No. 1..	7.99	½	5,400	3,700	1,000	6,800	851		
10	.62	.49	5.1	5	No. 1..	9.98	¼	5,900	2,400	700	6,400	645		
10	.62	.49	5.1	5	No. 1..	9.98	⅜	6,000	4,600	1,000	6,300	634		
10	.62	.49	5.1	5	No. 1..	9.98	½	6,300	4,400	1,000	6,300	634		
12	.62	.48	5.4	5	No. 1..	10.52	¼	6,500	4,600	900	6,800	646		
12	.62	.48	5.4	5	No. 1..	10.52	⅜	6,400	4,600	700	6,400	609		
12	.62	.48	5.4	5	No. 1..	10.52	½	6,800	4,400	1,000	6,900	656		
8	.62	.47	4.1	5	No. 1..	7.99	⅝	5,800	3,000	1,400	6,500	814	This lag screw was screwed into the narrow side of a block 5″×15″×11″. When tested the wood split 4″ on either side of the screw. Tested without plate A.	

TESTS OF ¾" LAG SCREWS IN DOUGLAS FIR.

Length of screw.	Description of screw.							Load at ¼" pull. Total.	Load at ½" pull. Total.	Load at ¾" pull. Total.	Adhesive resistance.		Remarks.
	Diameters.		Length of thread.	Threads per inch.	Kind of thread.	Resisting area.	Diameter of bored hole.				Total.	Per square inch.	
	Body.	Root of thread.											
Inches.	*Inch.*	*Inch.*	*Inches.*			*Sq. inches.*	*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
4½	.75	.57	2.5	4.5	No. 1..	5.89	5/16	3,100	3,000	1,300	3,300	560	
4½	.75	.57	2.5	4.5	No. 1..	5.89	¼	3,900	2,400	1,700	3,600	611	
4½	.75	.57	2.5	4.5	No. 1..	5.89	7/32	3,500	2,900	1,800	3,500	594	Wood split slightly.
5	.75	.57	3.0	4.5	No. 1..	7.07	5/16	3,900	3,400	1,900	4,100	580	
5	.75	.57	3.0	4.5	No. 1..	7.07	¼	4,200	3,400	2,400	4,400	622	
5	.75	.57	3.0	4.5	No. 1..	7.07	7/32	4,200	3,400	2,300	4,500	637	
6	.76	.56	3.3	4.5	No. 1..	7.88	5/16	4,200	3,600	2,700	5,100	647	
6	.76	.56	3.3	4.5	No. 1..	7.88	¼	5,200	4,500	3,700	5,300	673	
6	.76	.56	3.3	4.5	No. 1..	7.88	7/32	3,900	5,500	4,000	5,500	698	
8	.76	.58	4.1	4.5	No. 1..	9.79	5/16	7,200	5,800	3,800	8,100	827	
8	.76	.58	4.1	4.5	No. 1..	9.79	¼	8,000	6,600	4,700	8,200	838	
8	.76	.58	4.1	4.5	No. 1..	9.79	7/32	8,000	6,400	4,400	8,100	827	
9	.75	.56	4.9	4.5	No. 1..	11.55	5/16	7,200	6,600	5,800	7,200	623	
9	.75	.56	4.9	4.5	No. 1..	11.55	¼	6,300	7,800	6,000	8,200	710	
9	.75	.56	4.9	4.5	No. 1..	11.55	7/32	8,200	7,100	5,100	8,200	710	
10	.75	.58	5.5	4.5	No. 1..	12.96	5/16	7,200	6,300	5,100	8,700	671	
10	.75	.58	5.5	4.5	No. 1..	12.96	¼	8,700	8,200	5,200	9,400	725	
10	.75	.58	5.5	4.5	No. 1..	12.96	7/32	9,000	7,500	4,800	9,300	718	
12	.74	.56	6.0	4.5	No. 1..	13.95	5/16	9,700	8,900	4,300	10,000	717	
12	.74	.56	6.0	4.5	No. 1..	13.95	¼	9,900	8,000	4,600	10,100	724	
12	.74	.56	6.0	4.5	No. 1..	13.95	7/32	10,000	8,100	5,500	10,600	760	
8	.76	.58	4.1	4.5	No. 1..	9.79	¼	7,400	5,800	3,700	9,100	929	This lag screw was screwed into the middle of the narrow side of a block 5"×15"×11". When tested the wood split to ends of block. Tested without plate A.

TESTS OF ¼" LAG SCREWS IN DOUGLAS FIR.

5	.87	.63	2.9	4	No. 1..	7.93	⅛	4,800	3,700	1,900	4,800	605	
5	.87	.63	2.9	4	No. 1..	7.93	1/12	4,300	4,300	2,200	4,600	580	
5	.87	.63	2.9	4	No. 1..	7.93	¼	4,400	3,400	2,200	4,800	605	
7	.85	.68	2.9	4.5	No. 1..	7.74	⅛	6,600	4,800	1,800	6,600	853	For comparison of different pitches of threads.
7	.85	.68	2.9	4.5	No. 1..	7.74	1/12	5,300	4,100	2,800	6,400	827	
7	.85	.68	2.9	4.5	No. 1..	7.74	¼	6,500	5,300	3,200	6,500	840	
6	.88	.65	3.5	4	No. 1..	9.68	⅛	8,400	7,100	3,900	8,400	868	
6	.88	.65	3.5	4	No. 1..	9.68	1/12	8,600	7,000	4,400	8,800	909	
6	.88	.65	3.5	4	No. 1..	9.68	¼	8,200	6,200	3,400	9,100	940	
8	.86	.70	4.4	4	No. 1..	11.89	⅛	11,500	9,000	4,500	12,200	1,030	
8	.86	.70	4.4	4	No. 1..	11.89	1/12	12,200	9,300	5,500	12,600	1,060	
8	.86	.70	4.4	4	No. 1..	11.89	¼	12,600	9,600	6,800	12,800	1,080	
9	.86	.68	4.4	4	No. 2..	11.89	⅛	11,300	9,500	7,300	11,300	951	
9	.86	.68	4.4	4	No. 2..	11.89	1/12	9,600	7,300	6,400	11,600	976	
9	.86	.68	4.4	4	No. 2..	11.89	¼	11,300	7,800	5,000	12,300	1,030	
10	.88	.68	5.1	4.5	No. 1..	14.10	⅛	11,600	10,000	7,300	12,000	851	
10	.88	.68	5.1	4.5	No. 1..	14.10	1/12	13,200	10,100	7,300	13,200	936	
10	.88	.68	5.1	4.5	No. 1..	14.10	¼	13,300	10,400	6,800	13,300	943	
8	.86	.70	4.4	4	No. 1..	11.89	3/16	8,800	7,300	5,400	10,000	841	This lag screw was screwed into the middle of the narrow side of a block 4"×15"×11". When tested the wood split to the ends of the block. Tested without plate A.

TESTS OF 1" LAG SCREWS IN DOUGLAS FIR.

6	.99	.80	3.5	3.5	No. 1..	10.89	⅛	5,700	5,500	5,300	6,400	588
6	.99	.80	3.5	3.5	No. 1..	10.89	¼	6,400	5,700	.....	6,400	588
6	.99	.80	3.5	3.5	No. 1..	10.89	1/12	6,500	5,600	4,200	7,100	652
7	.99	.85	4	4.5	No. 1..	12.44	⅛	7,300	6,500	6,000	8,200	659
7	.99	.85	4	4.5	No. 1..	12.44	¼	7,400	6,600	5,100	8,300	667
7	.99	.85	4	4.5	No. 1..	12.44	1/12	8,200	7,500	6,400	8,200	659
8	.99	.80	4.4	3.5	No. 1..	13.68	⅛	7,500	6,500	3,000	7,500	548
8	.99	.80	4.4	3.5	No. 1..	13.68	¼	7,300	7,200	3,000	7,300	534
8	.99	.80	4.4	3.5	No. 1..	13.68	1/12	7,600	6,200	2,900	7,600	556

TESTS OF 1″ LAG SCREWS IN DOUGLAS FIR—Continued.

Length of screw.	Description of screw.							Load at ½″ pull. Total.	Load at ¼″ pull. Total.	Load at ½″ pull. Total.	Adhesive resistance.		Remarks.
	Diameters.		Length of thread.	Threads per inch.	Kind of thread.	Resisting area.	Diameter of bored hole.				Total.	Per square inch.	
	Body.	Root of thread.											
Inches.	*Inch.*	*Inch.*	*Inches.*			*Sq. inches.*	*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
9	1.00	.82	4.2	4.5	No. 1..	13.19	1⅜	7,600	6,000	5,000	7,600	576	Wood split slightly.
9	1.00	.82	4.2	4.5	No. 1..	13.19	½	6,500	6,100	5,900	7,400	561	
9	1.00	.82	4.2	4.5	No. 1..	13.19	1 1/16	7,900	7,000	4,500	7,900	599	For comparison of different pitches of threads.
8	.99	.80	4.2	3.5	No. 1..	13.06	1⅜	7,300	6,300	2,900	7,500	574	
8	.99	.80	4.2	3.5	No. 1..	13.06	½	7,000	5,600	5,000	7,600	582	
8	.99	.80	4.2	3.5	No. 1..	13.06	1 1/16	6,400	6,400	5,700	7,300	559	
8	.99	.80	4.4	3.5	No. 1..	13.68	½	8,200	4,900	3,500	9,100	665	This lag screw was screwed into the middle of the narrow side of a block 4″×15″×11″. When tested the wood split to ends of block. Tested without plate A.
8	.99	.80	4.4	3.5	No. 1..	13.68	½	9,800	7,700	3,500	10,300	753	Tested same as above, but in block 5½″×15″×11″. Wood split to ends of block.

TESTS OF ¼″ LAG SCREWS IN WHITE OAK.

[Tested without plate A, except where noted.]

4	.49	.37	2.3	5	No. 1..	3.54	½	5,000	3,500	1,000	5,600	1,580	
4	.49	.37	2.3	5	No. 1..	3.54	9/16	5,500	3,600	800	5,800	1,640	
4	.49	.37	2.3	5	No. 1..	3.54	⅝	5,300	3,200	1,200	6,400	1,810	
4½	.49	.37	2.8	5	No. 1..	4.31	½	6,000	5,200	700	6,300	1,460	
4½	.49	.37	2.8	5	No. 1..	4.31	9/16	6,200	4,400	1,400	6,700	1,550	
4½	.49	.37	2.8	5	No. 1..	4.31	⅝	6,100	4,500	2,000	6,400	1,480	
5	.48	.37	2.9	5	No. 1..	4.37	½	6,800	5,000	1,500	7,200	1,650	
5	.48	.37	2.9	5	No. 1..	4.37	9/16	5,800	4,100	1,200	7,000	1,600	
5	.48	.37	2.9	5	No. 1..	4.37	⅝	7,500	5,300	2,900	7,500	1,720	

5½	.46	.37	2.9	6	No. 2..	4.19	¾	5,800	3,200	1,000	6,200	1,480	
5½	.46	.37	2.9	6	No. 2..	4.19	1⅛	4,100	3,500	1,000	5,700	1,360	
5½	.46	.37	2.9	6	No. 2..	4.19	1½	5,200	4,200	2,000	6,400	1,530	
6	.48	.37	3	6½	No. 2..	4.52	¾	6,200	3,600	1,000	7,500	1,660	Plate A used.
6	.48	.37	3	6½	No. 2..	4.52	1⅛	5,900	4,200	1,100	7,200	1,590	Do.
6	.48	.37	3	6½	No. 2..	4.52	1½	8,300	3,600	2,500	8,300	1,840	Do.
7	.49	.37	3	5	No. 1..	4.62	¾	Two lag screws broke at 7,300 pounds each in a ¾" hole. Tensile strength = 67,900 pounds per square inch at root of thread.					Do.
6½	.48	.38	3.5	6.5	No. 2..	5.28	¾	8,400	8,200	2,300	8,600	1,630	Do.
6½	.48	.38	3.5	6.5	No. 2..	5.28	1⅛	8,800	6,300	2,400	8,800	1,670	Do.
6½	.48	.38	3.5	6.5	No. 2..	5.28	1½	Steel screw. Broke at 9,300 pounds = 82,020 pounds per square inch at root of thread.					Do.
8	.48	.37	3.5	5	No. 1..	5.28	¾	Broke at 7,400 pounds in a ¾" hole. Tensile strength = 68,830 pounds per square inch at root of thread.					Do.

TESTS OF ¾" LAG SCREWS IN WHITE OAK.

[Tested without plate A, except where noted.]

3½	.62	.47	2	5	No. 2..	3.90	¾	3,500	2,300	900	4,700	1,210	
3½	.62	.47	2	5	No. 2..	3.90	1⅛	3,900	2,500	1,000	5,200	1,330	
3½	.62	.47	2	5	No. 2..	3.90	1½	4,100	2,900	1,300	5,200	1,330	
4	.61	.48	2.2	5	No. 2..	4.22	¾	4,000	2,400	900	5,300	1,260	
4	.61	.48	2.2	5	No. 2..	4.22	1⅛	4,700	3,900	1,600	5,500	1,300	
4	.61	.48	2.2	5	No. 2..	4.22	1½	4,000	3,200	1,300	5,300	1,260	
4½	.62	.50	2.4	5	No. 2..	4.67	¾	5,300	3,700	1,300	6,400	1,370	
4½	.62	.50	2.4	5	No. 2..	4.67	1⅛	5,400	4,500	1,500	6,100	1,310	
4½	.62	.50	2.4	5	No. 2..	4.67	1½	5,400	4,300	1,500	6,100	1,310	
5	.61	.48	3	5	No. 1..	5.75	¾	7,100	5,100	2,000	7,600	1,320	
5	.61	.48	3	5	No. 1..	5.75	1⅛	7,900	7,500	2,700	8,500	1,480	
5	.61	.48	3	5	No. 1..	5.75	1½	8,100	6,200	3,300	8,100	1,410	
5½	.60	.46	3	5	No. 2..	5.66	¾	7,200	4,300	1,900	7,300	1,290	
5½	.60	.46	3	5	No. 2..	5.66	1⅛	7,200	4,500	1,700	7,200	1,270	
5½	.60	.46	3	5	No. 2..	5.66	1½	7,200	5,200	1,900	7,200	1,270	
6	.60	.47	3.5	5	No. 1..	6.60	¾	8,400	4,300	2,300	10,200	1,550	
6	.60	.47	3.5	5	No. 1..	6.60	1⅛	9,700	6,300	2,800	9,700	1,470	Plate A used.
6	.60	.47	3.5	5	No. 1..	6.60	1½	7,100	5,500	2,000	9,600	1,450	Do.

TESTS OF ¼" LAG SCREWS IN WHITE OAK—Continued.

Length of screw.	Description of screw.							Load at ¼" pull. Total.	Load at ¼" pull. Total.	Load at ¼" pull. Total.	Adhesive resistance.		Remarks.
	Diameters.		Length of thread.	Threads per inch.	Kind of thread.	Resisting area.	Diameter of bored hole.				Total.	Per square inch.	
	Body.	Root of thread.											
Inches.	*Inch.*	*Inch.*	*Inches.*			*Sq. inches.*	*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
7	.61	.48	3.9	5	No. 1..	7.47	¼	7,900	4,100	2,300	8,800	1,180	Plate A used.
7	.61	.48	3.9	5	No. 1..	7.47	7/32	7,700	5,800	2,600	8,800	1,180	Do.
7	.61	.48	3.9	5	No. 1..	7.47	⅜	8,500	6,200	2,800	8,500	1,140	Do.
8	.62	.47	4.1	5	No. 1..	7.99	¼	9,200	6,700	2,300	10,400	1,300	Do
8	.62	.47	4.1	5	No. 1..	7.99	7/32	7,900	5,800	3,200	9,500	1,190	Do.
8	.62	.47	4.1	5	No. 1..	7.99	⅜	10,000	7,700	3,600	10,900	1,360	Do.
10	.62	.49	5.1	5	No. 1..	9.93	¼	11,500	8,200	4,200	11,500	1,160	Do.
10	.62	.49	5.1	5	No. 1..	9.93	7/32	11,000	7,300	4,200	11,400	1,150	Do.
10	.62	.49	5.1	5	No. 1..	9.93	⅜	9,800	6,400	3,500	10,600	1,067	Do.
12	.62	.48	5.4	5	No. 1..	10.52	¼	Broke at 11,700 pounds=tensile strength 64,640 pounds per square inch at root of thread.					Do.
12	.62	.48	5.4	5	No. 1..	10.52	⅜	Broke at 11,600 pounds=tensile strength 64,080 pounds per square inch at root of thread.					Do.

TESTS OF ¼" LAG SCREWS IN WHITE OAK.

[Tested with plate A.]

4½	.75	.57	2.5	4.5	No. 1..	5.89	9/32	8,500	6,700	3,500	8,800	1,490	
4½	.75	.57	2.5	4.5	No. 1..	5.89	¼	9,200	7,200	4,400	9,300	1,580	
4½	.75	.57	2.5	4.5	No. 1..	5.89	7/32	9,400	7,700	4,300	9,400	1,600	
5	.75	.57	3	4.5	No. 1..	7.07	9/32	9,300	7,900	3,600	9,700	1,370	
5	.75	.57	3	4.5	No. 1..	7.07	¼	9,300	8,500	4,800	9,900	1,400	
5	.75	.57	3	4.5	No. 1..	7.07	7/32	9,900	9,100	3,700	10,000	1,410	
6	.76	.56	3.3	4.5	No. 1..	7.88	9/32	10,100	8,900	4,300	10,100	1,280	
6	.76	.56	3.3	4.5	No. 1..	7.88	¼	8,900	8,000	6,200	9,800	1,240	
6	.76	.56	3.3	4.5	No. 1..	7.88	7/32	10,000	9,000	5,200	10,100	1,280	

8	.76	.58	4.1	4.5	No. 1..	9.79	⅜	13,700	9,200	6,700	13,700	1,400
8	.76	.58	4.1	4.5	No. 1..	9.79	½	13,300	10,600	6,000	13,400	1,370
8	.76	.58	4.1	4.5	No. 1..	9.79	⅞	10,900	8,900	5,400	12,100	1,240
9	.75	.56	4.9	4.5	No. 1..	11.55	⅜	12,700	9,400	6,000	12,700	1,100
9	.75	.56	4.9	4.5	No. 1..	11.55	½	12,200	9,200	6,600	12,200	1,060
9	.75	.56	4.9	4.5	No. 1..	11.55	⅞	11,200	8,300	5,600	11,200	970
10	.75	.58	5.5	4.5	No. 1..	12.96	⅜	12,100	8,200	5,100	12,300	950
10	.75	.58	5.5	4.5	No. 1..	12.96	½	12,300	10,200	5,900	12,400	957
10	.75	.58	5.5	4.5	No. 1..	12.96	⅞	12,200	11,000	6,700	12,800	988
12	.74	.56	6	4.5	No. 1..	13.95	⅜	14,500	14,000	7,300	14,700	1,050
12	.74	.56	6	4.5	No. 1..	13.95	½	14,400	14,600	8,500	14,900	1,070
12	.74	.56	6	4.5	No. 1..	13.95	⅞	14,500	11,200	5,200	14,700	1,050

TESTS OF ¾" LAG SCREWS IN WHITE OAK.

[Tested with plate A.]

5	.87	.63	2.9	4	No. 1..	7.93	½	9,800	7,500	4,400	10,500	1,320
5	.87	.63	2.9	4	No. 1..	7.93	⅝	7,800	5,400	4,200	8,900	1,120
5	.87	.63	2.9	4	No. 1..	7.93	¾	9,500	5,800	4,500	9,900	1,250
6	.88	.65	3.5	4	No. 1..	9.68	½	11,700	9,200	6,300	12,200	1,260
6	.88	.65	3.5	4	No. 1..	9.68	⅝	10,800	9,200	6,200	11,400	1,180
6	.88	.65	3.5	4	No. 1..	9.68	¾	9,700	7,800	4,800	11,300	1,170
7	.85	.68	2.9	4.5	No. 1..	7.74	½	8,600	5,500	3,400	9,400	1,210
7	.85	.68	2.9	4.5	No. 1..	7.74	⅝	8,300	5,600	3,300	9,000	1,160
7	.85	.68	2.9	4.5	No. 1..	7.74	¾	8,000	6,400	3,400	8,600	1,110
8	.86	.70	4.4	4	No. 1..	11.89	½	13,100	9,100	4,600	13,100	1,100
8	.86	.70	4.4	4	No. 1..	11.89	⅝	13,900	10,000	6,700	14,000	1,180
8	.86	.70	4.4	4	No. 1..	11.89	¾	11,200	9,300	6,200	13,300	1,120
9	.86	.68	4.4	4	No. 2..	11.89	½	11,500	10,200	4,800	12,000	1,010
9	.86	.68	4.4	4	No. 2..	11.89	⅝	11,300	10,700	6,100	11,700	984
9	.86	.68	4.4	4	No. 2..	11.89	¾	11,600	10,400	6,400	12,700	1,070
10	.88	.68	5.1	4.5	No. 1..	14.10	½	14,600	13,400	7,600	15,600	1,110
10	.88	.68	5.1	4.5	No. 1..	14.10	⅝	14,000	11,800	8,500	14,300	1,010
10	.88	.68	5.1	4.5	No. 1..	14.10	¾	14,800	13,200	9,900	15,600	1,110

TESTS OF 1" LAG SCREWS IN WHITE OAK.

[Tested with plate A.]

Description of screw.								Load at ¼" pull. Total.	Load at ½" pull. Total.	Load at ¼" pull. Total.	Adhesive resistance.		Remarks.
Length of screw.	Diameters.		Length of thread.	Threads per inch.	Kind of thread.	Resisting area.	Diameter of bored hole.				Total.	Per square inch.	
	Body.	Root of thread.											
Inches.	*Inch.*	*Inch.*	*Inches.*			*Sq. inches.*	*Inch.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	*Pounds.*	
6	.99	.80	3.5	3.5	No. 1..	10.89	13/16	12,200	10,000	5,500	12,200	1,120	
6	.99	.80	3.5	3.5	No. 1..	10.89	7/8	14,700	12,000	7,400	14,700	1,350	
6	.99	.80	3.5	3.5	No. 1..	10.89	15/16	12,400	8,500	4,600	13,800	1,270	
7	.99	.85	4	4.5	No. 1..	12.44	13/16	14,600	12,100	5,700	14,700	1,180	
7	.99	.85	4	4.5	No. 1..	12.44	7/8	11,800	14,100	7,800	15,000	1,210	
7	.99	.85	4	4.5	No. 1..	12.44	15/16	11,500	14,900	9,500	16,100	1,290	
8	.99	.80	4.4	3.5	No. 1..	13.68	13/16	14,800	15,000	6,400	16,200	1,180	
8	.99	.80	4.4	3.5	No. 1..	13.68	7/8	15,200	14,300	6,900	15,500	1,130	
8	.99	.80	4.4	3.5	No. 1..	13.68	15/16	16,300	16,300	11,100	17,300	1,260	
9	1.00	.82	4.2	4.5	No. 1..	13.19	13/16	13,200	11,100	4,600	14,900	1,130	
9	1.00	.82	4.2	4.5	No. 1..	13.19	7/8	11,900	13,200	6,200	14,700	1,110	
9	1.00	.82	4.2	4.5	No. 1..	13.19	15/16	14,400	12,500	8,200	15,300	1,160	
8	.99	.80	4.2	3.5	No. 1..	13.06	13/16	15,100	14,000	7,400	15,400	1,180	
8	.99	.80	4.2	3.5	No. 1..	13.06	7/8	12,300	8,300	4,200	13,300	1,020	
8	.99	.80	4.2	3.5	No. 1..	13.06	15/16	12,600	12,300	6,800	13,600	1,040	

Tests of the adhesion of plain wrought-iron bolts with pointed ends, driven into Douglas fir and white-oak wood.

Tested in manner similar to that of lag screws.

Reinforcing plate "A" used.

Bolts driven into timber to a depth corresponding to the longest lag screws.

BOLTS DRIVEN INTO 8" × 8" × 4' STICKS OF DOUGLAS FIR.

Nominal diameter of bolt.	Actual diameter of bolt.	Depth of full-sized iron in wood.	Resisting area.	Diameter of bored hole.	Adhesive resistance.		Remarks.
					Total.	Per square inch.	
Inch.	*Inch.*	*Inches.*	*Sq. ins.*	*Inch.*	*Pounds.*	*Pounds.*	
1	.99	4.4	13.68	1 1/8	3,900	285	
1	.99	4.4	13.68	1	6,700	490	
7/8	.87	5.1	13.94	1 1/8	5,000	359	
7/8	.87	5.1	13.94	1	6,800	488	
3/4	.76	6	14.33	1 1/8	4,800	343	
3/4	.76	6	14.33	1	4,200	293	
3/4	.76	6	14.33	7/8	6,100	426	
5/8	.65	5.4	11.03	7/8	3,600	326	
5/8	.65	5.4	11.03	1	5,800	526	
5/8	.65	5.4	11.03	7/8	6,700	607	
1/2	.51	3.5	5.61	7/8	2,100	374	
1/2	.51	3.5	5.61	1	2,900	517	
1/2	.51	3.5	5.61	7/8	3,500	624	
1/2	.51	3.5	5.61	1	3,600	643	
1/2	.51	3.5	5.61	7/8	4,150	741	
1/2	.51	3.5	5.61	0	4,100	714	No hole bored.
5/8	.65	5.4	11.03	1	8,400	762	
5/8	.65	5.4	11.03	7/8	7,200	653	
3/4	.76	6	14.33	1	9,400	656	
3/4	.76	6	14.33	7/8	8,600	600	
7/8	.87	5.1	13.94	1 1/8	8,000	574	
7/8	.87	5.1	13.94	1	9,700	696	
7/8	.87	5.1	13.94	7/8	7,000	502	
1	.99	4.4	13.68	1 1/8	9,900	724	
1	.99	4.4	13.68	1	7,500	548	

BOLTS DRIVEN INTO 11" × 4" × 4' STICKS OF WHITE OAK.

1	.99	4.4	13.68	1	10,800	789	
1	.99	4.4	13.68	1 1/8	14,300	1,050	
1	.99	4.4	13.68	1	14,100	1,030	
7/8	.87	5.1	13.94	1	12,000	861	Split slightly.
7/8	.87	5.1	13.94	1 1/8	13,200	947	
7/8	.87	5.1	13.94	1	13,200	947	
7/8	.87	5.1	13.94	1 1/8	5,200	373	
3/4	.76	6	14.33	1	11,300	789	
3/4	.76	6	14.33	1	11,700	816	
3/4	.76	6	14.33	1 1/8	6,400	447	
3/4	.76	6	14.33	1	.....	.....	Split the wood.
5/8	.65	5.4	11.03	1	.....	.....	Do.
5/8	.65	5.4	11.03	1	12,900	1,120	
5/8	.65	5.4	11.03	7/8	13,300	1,210	
5/8	.65	5.4	11.03	1	13,200	1,200	
1/2	.51	3.5	5.61	1	6,400	1,140	
1/2	.51	3.5	5.61	1	7,200	1,280	
1/2	.51	3.5	5.61	7/8	7,400	1,320	

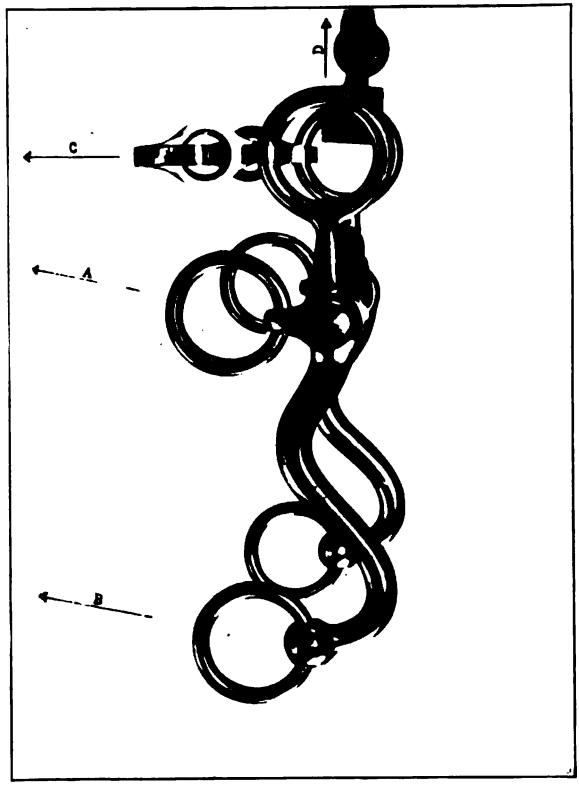
Adhesion of lag screws in yellow pine wood.
Screws driven in bored holes, perpendicular to the grain.

Diameter—			Depth in wood.	Resisting area.	Adhesive resistance.		Remarks.
Of body.	At root of thread.	Bored hole.			Total.	Per square inch.	
Inch.	*Inch.*	*Inch.*	*Inches.*	*Sq. inches.*	*Pounds.*	*Pounds.*	
.75	.63	.625	4.5	10.60	8,620	813	Pulled off head of screw.
.75	.63	.625	4.5	10.60	7,890	744	Do.
Slot in lag screws filled with a steel key.							
.75	.63	.625	4.5	10.60	8,200	774	Pulled screw out of the wood.
.75	.63	.625	5.625	13.25	10,300	777	Do.

TENSILE TESTS OF REGULATION STEEL NICKEL-PLATED BIT

AND

A MAGNOLIA METAL BIT.



PHOTOGRAPH SHOWING DIRECTIONS OF APPLYING LOADS.

BITS.

TEST OF STEEL BIT.

Part tested.	Diameter of wire.	Tensile strength.	Remarks.
	Inch.	*Pounds.*	
A	.181	2,790	Rings decidedly distorted at 700 to 800 pounds.
A	.181	1,920	Fractured along scarf weld.
B	.185	2,530	Fractured the ring.
B	.185	2,610	Do.
C		268	Pulled curb attachment from eye in bit.
C		254	Do.
D	a.235	3,455	Fractured at junction of mouthpiece and branch.
D	a.235	3,640	Do.

TEST OF MAGNOLIA METAL BIT.

A	.182	1,864	Rings decidedly distorted at 450 pounds.
A	.182	1,456	Do.
B	.185	1,556	Fractured branch of the bit.
B	.185	2,215	Fractured eye, carrying ring.
C		218	Pulled curb attachment from eye in bit.
C		246	Do.
D	a.25	2,740	Fractured the eye.
D	a.25	2,545	Do.
Mouthpiece	a.496	8,200	Appearance of fracture, light lemon yellow, uniform. Sectional area, minimum diameter of mouthpiece, .193 square inch. Tensile strength, no correction made for curved shape, 42,490 pounds per square inch.

a Diameter of metal.

CARTRIDGE AND TARGET CLOTH.

Test No. 10453.

CARTRIDGE CLOTH.

Five samples received: Two samples, Nos. 1 and 8, from J. Wanamaker. Three samples, "S. C." and "F. & S.," from Germany, delivered on contract at New York Arsenal.

Samples 2″ wide by 10″ long between the jaws of the testing machine.

Marks.	Direction tested.	Elongation in 8 inches.	Tensile strength.	Remarks.
		Inches.	*Pounds.*	
No. 1	Filling	1.10	120	
Do	do	1.13	128	
No. 8	do	.98	145	
Do	do	.83	133	

Samples 2″ wide by 3″ long between jaws of the testing machine.

No. 1	Warp		153	From J. Wanamaker.
Do	Filling		132	Do.
No. 8	Warp		173	Do.
Do	Filling		148	Do.
S. C	Unknown		177	From Germany.
F. & S.	do		98	Do.
Do	Warp		80	Do.

Test No. 10455.

TARGET CLOTH.

Two pieces of cloth tested. Two samples taken from warp and two from filling of each piece.

Samples 2″ wide by 10″ long between the jaws of the testing machine.

Marks.	Direction tested.	Elongation in 8 inches.	Tensile strength.
		Inches.	*Pounds.*
No. 9	Warp	1.17	111
Do	do	1.06	114
Do	Filling	1.27	114
Do	do	1.23	113
No. 10	Warp	1.16	154
Do	do	1.09	151
Do	Filling	.96	138
Do	do	.88	130

Blue Print Paper.

Samples 1″ wide by 3″ long between the jaws of the testing machine.

No. of sample.	Thickness.	Tensile strength.	Mean.	Remarks.
	Inch.	*Pounds.*	*Pounds.*	
2	.046	39.5	.....	
.....	.....	45	.....	
.....	.....	43	42.5	
3	.049	27.5	.....	
.....	.....	26	.....	
.....	.....	27.5	27	
4	.052	28.5	.....	
.....	.....	28	.....	
.....	.....	27.5	28	
5	.053	25	.....	
.....	.....	25.5	.....	
.....	.....	26.5	25½	
6	.037	29	.....	
.....	.....	29	.....	
.....	.....	32	30	

CHEMICAL ANALYSES.

CHEMICAL ANALYSES.

BRASS, ETC.

Description.	Copper.	Tin.	Zinc.	Lead.	Antimony.	Nickel.
Brass wire from Springfield Armory	60.50	.....	39.50	.....	.....	.....
Backing of embossed belt buckle, U. S	.....	40.00	.....	60.00	.....	.....
White metal for yacht hand-rail stanchion	48.44	.....	36.58	.....	.....	14.82
Torrey antifriction metal	.....	.....	.....	81.06	19.00	.....

STEELS FROM SPRINGFIELD ARMORY.

Description.	Marks.	Carbon.	Manganese.	Silicon.	Sulphur.	Phosphorus.	Copper.
Receiver steel	M1	.305	.995	.106	.034	.040	.....
Do	M2	.308	.990	.105	.036	.036	.....
Do	M3	.316	1.033	.103	.036	.039	.....
Do	M4	.308	1.000	.109	.037	.036	.....
Do	M5	.360	1.020	.114	.030	.038	.....
Do	.....	.305	.990	.030	.056	.090	.....
Receiver steel, old stock	.....	.120	.830	.035	.076	.062	.....
"Carpenter"	.....	.470	1.550	.194	.032	.034	.110
Bayonet steel	.....	1.040	.300	.240	.020	.015	.....
Do	.....	1.02	.410	.166	.040	.030	.....
Do	.....	.820	.680	.240	.035	.037	.....
Do	1	.954	.285	.050	.030	.015	.....
Do	2	1.000	.310	.106	.025	.014	.....
Russian steel	.....	.950	.180	.162	.015	.008	.....

MISCELLANEOUS STEELS.

Rimbase of hardened 16" trunnion hoop, Watervliet Arsenal	.....	.580	.700	.244	.020	.034	.095
Pressure-gauge plug, Frankford Arsenal	.....	1.115	.300	.245	.010	.016	.....

PRIVATE TESTS.

TESTS MADE FOR PRIVATE PARTIES DURING THE FISCAL YEAR ENDED JUNE 30, 1902.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1901.				
July 2	Steel bars	Boston Elevated Railway Co	Boston	Mass.
	do	Wetherell Brothers	do	Mass.
3	do	New England Bolt and Nut Co	do	Mass.
23	Steel specimens	United States Projectile Co	New York	N. Y.
Aug. 5	Steel anchor bolt	New England Bolt and Nut Co	Boston	Mass.
	"Fibre"	Laminar Fibre Co	North Cambridge	Mass.
8	Rubber belting	Revere Rubber Co	Chelsea	Mass.
12	Gauges	American Steam Gauge and Valve Co.	Jamaica Plain	Mass.
15	Belting and canvas	William T. Plummer	Boston	Mass.
17	Brick	New England Fire Proofing Co.	do	Mass.
28	Cast iron	Wm. Allen & Sons	Worcester	Mass.
31	Shackles	Fletcher & Crowell Co	Portland	Me.
	Concrete	Wm. Wirt Clarke & Sons	Baltimore	Md.
Sept. 3	do	do	do	Md.
7	Riveted joint	Edward Kendall & Sons	Cambridgeport	Mass.
12	Hardened blocks	Chapman Double Ball Shafting Bearing Co.	Boston	Mass.
13	Cast iron	Wm. Allen & Sons	Worcester	Mass.
	Spliced belting	Main Belting Co	Boston	Mass.
	Sheaves	Boston and Lockport Block Co.	do	Mass.
24	Cast iron	Golding & Co	do	Mass.
27	Paving bricks	D. J. Curtis & Son	Springfield	Mass.
28	Column	Lally Patent Column Co	Waltham	Mass.
Oct. 11	Cast iron	Barbour-Stockwell Co	Cambridgeport	Mass.
12	Wire rope	Carson Trench Machine Co	Boston	Mass.
16	Stone slabs	Daniel Kilpatrick	Morning Sun	Iowa.
	Cotton belt	The Carton Belting Co	Boston	Mass.
19	Whiting	Hood Rubber Co	Watertown	Mass.
24	Cast iron	John Souther & Co	Boston	Mass.
26	Sandstone	Barclay Bros	Sinnamahoning	Pa.
29	Cotton fiber	American Rubber Tire Co	Boston	Mass.
	Rubber	Hood Rubber Co	Watertown	Mass.
Nov. 4	Crude rubber	do	do	Mass.
8	Barrel steel	Savage Arms Co	Utica	N. Y.
13	Steel casting	Fiske Brick Co	Boston	Mass.
	Cement	The Alpena Portland Cement Co	Alpena	Mich.
26	U bolt	Boston and Albany Railroad Co.	Boston	Mass.
27	Cast iron	Whittier Machine Co	do	Mass.
Dec. 4	Hooks	Boston and Lockport Block Co	do	Mass.
11	Wire nails	J. C. Pearson Co	do	Mass.
19	Cotton duck, etc	Catlin & Co	do	Mass.
20	Marble	Vermont Marble Co	Proctor	Vt.
23	Bricks	Washington Hydraulic Press Brick Co.	Washington	D. C.
26	Steel	E. D. Leavitt	Cambridge	Mass.
27	Rubber	Hood Rubber Co	Watertown	Mass.
31	Bricks	New England Brick Co	Boston	Mass.
1902.				
Jan. 6	Wire nails	J. C. Pearson Co	do	Mass.
7	Rubber	Hood Rubber Co	Watertown	Mass.
11	Granite	Milford Pink Granite Construction Co.	Milford	Mass.
18	Shackles	Fletcher & Crowell Co	Portland	Me.
22	Push bars	Boston Transit Commission	Boston	Mass.
23	Iron bar	New England Bolt and Nut Co.	do	Mass.
27	Semi-steel casting	Fiske Brick Co	do	Mass.
Feb. 7	Concrete	New York, New Haven and Hartford Railroad Co.	Bridgeport	Conn.
8	Steel specimens	Savage Arms Co	Utica	N. Y.
	Steel bars	Boston Elevated Railway Co	Boston	Mass.
10	do	Sullivan Machinery Co	Claremont	N. H.
11	Artificial stone	Murdock Parlor Grate Co	Boston	Mass.
13	Rubber shoe	Hood Rubber Co	Watertown	Mass.
20	Cement briquettes	Fiske & Co	Boston	Mass.
21	Building blocks	Pittsburg Brick and Pipe Co	Pittsburg	Kans.
	Stone	New York, New Haven and Hartford Railroad Co.	Bridgeport	Conn.
24	Limestone	Standard Plaster Co	Buffalo	N. Y.
Mar. 1	Shackles	Fletcher & Crowell Co	Portland	Me.
6	Boiler plate	Wm. Allen & Sons Co	Worcester	Mass.
7	Steel bars	Fore River Ship and Engine Co.	Quincy	Mass.
11	Steel plates	New England Structural Co	Boston	Mass.

TESTS MADE FOR PRIVATE PARTIES, ETC.—Continued.

Date.	Material.	For whom tested.		
		Name.	City.	State.
1902.				
Mar. 17	Cement	Murdock Parlor Grate Co	Boston	Mass.
20	Iron	Laconia Car Co. Works	....do	Mass.
24	Pipe fittings	The Perfection Cleanout Specialty Co.	Haverhill	Mass.
	Cast iron	Sheaff & Jaastad	Boston	Mass.
26	Hollow bricks	George A. Fuller Co	....do	Mass.
	Manhole covers	City of Boston	....do	Mass.
28	Cast iron	Hyde Windlass Co	Bath	Me.
29	Steel plate	American Locomotive Co	Schenectady	N. Y.
Apr. 3	Concrete	Frank A. Hinds	Watertown	N. Y.
9	Rubber, belting, etc.	Boston Woven Hose and Rubber Co.	Boston	Mass.
11	Wrought iron	Laconia Car Co. Works	....do	Mass.
15	Cast iron	Hyde Windlass Co	Bath	Me.
28	....do	Whittier Machine Co	Boston	Mass.
May 2	Steel specimens	Remington Arms Co	Ilion	N. Y.
	....do	Marlin Firearms Co	New Haven	Conn.
6	Cast iron	Bath Iron Works	Bath	Me.
7	Rubber spring	Boston Woven Hose and Rubber Co.	Boston	Mass.
20	Chain	International Paper Co	Bellows Falls	Vt.
	Turnbuckles	The Thomas Laughlin Co	Portland	Me.
22	Tie rods	Boston Elevated Railway Co	Boston	Mass.
	Cast-iron lifting finger.	Fiske Brick Co	....do	Mass.
	Stay bolt iron	Houghton & Richards	....do	Mass.
23	Cotton fleece	Hood Rubber Co	Watertown	Mass.
24	Concrete	New York, New Haven and Hartford Railroad Co	Bridgeport	Conn.
29	Litholite	Uriah Cummings	Akron	N. Y.
	Stone	Edw. W. Serrell	Washington	D. C.
	Sandstone	Traverse Bay Red Stone Co	Calumet	Mich.
June 3	Steel specimen	The Savage Arms Co	Utica	N. Y.
4	Coated nails	J. C. Pearson Co	Boston	Mass.
	Cast iron	Bath Iron Works	Bath	Me.
	Fabric	Hood Rubber Co	Watertown	Mass.
	Steel rods in concrete.	Boston Transit Commission	Boston	Mass.
	Rail shoe plates	The Weber Railway Joint Manufacturing Co.	New York	N. Y.
7	Lag screw expansion sleeve nuts.	Stannard Manufacturing Co	Springfield	Mass.
21	Steel rods in concrete, etc.	Boston Transit Commission	Boston	Mass.
24	Shackles	Fletcher & Crowell Co	Portland	Me.
	Rubber belting	Revere Rubber Co	Chelsea	Mass.
30	Nails	J. C. Pearson Co	Boston	Mass.

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